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DRAINAGE CHANNEL AND WATERWAY

ESTATE OF E. L. COOLEY

A HISTORY OF
THE EFFORT TO SECURE AN EFFECTIVE AND HARMLESS METHOD FOR THE
DISPOSAL OF THE SEWAGE OF THE CITY OF CHICAGO, AND TO
CREATE A NAVIGABLE CHANNEL BETWEEN LAKE
MICHIGAN AND THE MISSISSIPPI RIVER

By G. P. BROWN

PREPARED UNDER THE DIRECTION OF THE SPECIAL COMMITTEE ON CEREMONIES AT THE
INAUGURATION OF WORK ON THE DRAINAGE CHANNEL AND WATERWAY, SEPTEMBER
3, 1892, PURSUANT TO A RESOLUTION PASSED BY THE CITIZENS WHO
PARTICIPATED IN THOSE CEREMONIES, AND BY THE AUTHORITY
OF THE BOARD OF TRUSTEES OF THE SANITARY
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P R E F A C E.

Chicago stands at the summit of the watershed between the basins of the Mississippi and the St. Lawrence, yet its drainage problem has been a most perplexing one. This has been due, in part, to the fact that the great lake at the city's feet has been both the source of its water supply and the receptacle for its sewage. The inability to reconcile these conflicting conditions became apparent many years ago, but the city was unwilling to make a radical change in its methods. With a perpetual fountain of unparalleled water on one side from which to draw at will, and a declivity on the other down which the waste might be discharged, an ideal plan of sewage disposal was offered. But there were long believed to be insurmountable obstacles to its adoption. One makeshift followed another, and the people were urged to believe that it was neither dangerous nor obnoxious to drink diluted sewage.

At length the conclusion was forced upon the municipality that the public drains must be turned away from Lake Michigan. The disposal of sewage upon land was found to be impracticable and chemical treatment impossible. The inhabitants of the valleys of the Desplaines and Illinois rivers protested against the contamination of those streams. It was finally shown that sewage soon became harmless and inoffensive if properly diluted. At

the price of a serviceable waterway between Lake Michigan and the Illinois river, with consequent dilution, all objections to the construction of a drainage channel to the westward were withdrawn.

Such is the origin of the drainage channel and waterway. It is a work of great magnitude, ranking among the largest of the century. Chicago's prosperity is dependent upon it. The commercial welfare of the State will be augmented by it. When the United States Government shall have completed the navigable highway in the bed of the Illinois the entire country will be benefited. In time of war with a foreign power, whose advent no one can foretell, it will be the means of saving millions of dollars in the protection of the cities on the great lakes. Both State and Nation thus have a vital interest in the work.

The idea of an artificial waterway from Lake Michigan to the Mississippi river dates from the discovery of this western country, its first suggestion having been made by Joliet who, with Marquette, more than three hundred years ago, explored the valleys of the Desplaines and Illinois. Among the internal improvements of the country proposed in the early part of this century was the construction of a canal between Lake Michigan and the Mississippi suitable for the commerce of the West. The National government has given the question consideration for nearly one hundred years.

The channel so long urged is now in the hands of contractors. It will extend from Chicago to Joliet, a distance of forty miles, and will be adequate for vessels

navigating the Great Lakes and the Great River. It is being constructed at the expense of a municipality which includes the greater part of the city of Chicago and portions of adjoining townships. Its extension to the Mississippi will depend upon the State and the National Government.

In the following pages an effort has been made to trace the development of the idea of this waterway communication from its inception to the date when it took definite shape in the inauguration of work. If a compilation were made of all that has been said and done concerning the subject it would fill a hundred volumes. No public question relating to the physical improvement of the country ever received closer and more prolonged attention. Such facts have been gleaned from the mass of material uncovered as seemed necessary to a connected and comprehensive history.

According to present plans the channel now begun will be completed in 1896. Chicago will then have secured satisfactory drainage, and the advantages of a new highway of commerce from the lakes to the gulf will have become apparent to State and Nation.

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ARTES SCIENTIA VERITAS

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DRAINAGE CHANNEL AND WATERWAY.

CHAPTER I.

WATER SUPPLIES OF LARGE CITIES.

Chicago is the only great city in the world that has easy access to an unlimited supply of pure water,—not the chemically pure product of distillation, but that which is free from organic pollution. Water is suitable for domestic use when it does not contain matter which is itself poisonous, or which is food for disease-producing bacteria. In its natural state, the water of Lake Michigan contains no trace of such matter, and in this sense is pure.

Not only does Chicago obtain unrivalled water from an exhaustless reservoir, but from one which lies at its very door. It needs to build no costly aqueducts, construct no artificial storage basins, and make no provision against drought. Nature has fairly lifted the cup to Chicago's lips. Lake Michigan has been one of the sources of the city's unrivalled prosperity. Good water flows through the arteries of a city as pure blood through the body, refreshing and sustaining it. Without wholesome water there can be no permanent aggregation of people. The growth of cities is limited by their ability to secure and maintain a suitable supply of water. The struggle for it is often so great as to excite pity. Vast sums of money are spent and useful lives sacrificed. Energies which should be used in developing commerce and manufactures are wasted in a warfare with nature.

New York was compelled to go into the country forty

miles and collect the waters of small streams into artificial lakes. These are more or less contaminated, and constant efforts are required to check the pollution. Dams, aqueducts and tunnels have cost the city nearly \$30,000,000, and still the system must be extended as the city grows. Plans have been adopted recently for the construction of a new dam which will collect the waters of a region 376 square miles in extent. This and its auxiliaries will cost \$5,000,000, and six years will be required for its completion.

Boston goes to Lake Cochituate for its water supply, a distance of twenty miles, and has paid more than \$10,000,000 for storage reservoirs and a brick conduit.

Philadelphia is supplied mainly from the Schuylkill River, whose waters are deleteriously affected by the sewage of towns, and the waste of factories. Three plans for an improved supply are now under consideration, any one of which will cost not less than \$20,000,000.

London obtains about one-half the water it uses from the Thames above tidal limits, and the remainder from smaller streams and springs. At the present rate of increase in the population of the city it is estimated that, within thirty years, the amount required will exceed the supply of the entire Thames basin in times of drought. In the near future it will be necessary to provide increased storage capacity, or discover new sources of supply. Dr. Frankland says the water of the Thames and Lea is becoming more and more unfit for domestic use, on account of sewage pollution, notwithstanding the most efficient means of filtration are employed at the reservoirs.

Paris derives its supply from the Seine, the Marne, the Ourcq canal, artesian wells and springs. Only that from the wells and springs is fit for domestic use and this is limited in amount. Expensive works have been required to conduct the water supply from the various sources to reser-

voirs on heights near the city. The main aqueduct is 110 miles in length, and there are subsiding conduits 50 miles long.

Vienna goes to the Styrian Alps for water, a distance of 56 miles. Marseilles also depends upon the melting snows of the Alps, and the canal it constructed to the Durance was one of the boldest undertakings of modern times. This canal is carried through three chains of limestone mountains, which are penetrated by forty-five tunnels. It crosses many valleys by aqueducts, one of which, carrying 198,000 gallons per minute, is 262 feet in height.

Manchester built seven impounding reservoirs, whose embankments are from 70 to 100 feet above the level of the valley in which they are constructed. The water with which they are filled is collected from the River Etherow and its tributaries, and is conveyed by an aqueduct 20 miles in length. The gross supply from the entire drainage ground will not exceed 40,000,000 gallons daily.

Versailles spent large sums of money and sacrificed many lives in an unsuccessful attempt to bring water from the River Eure, and the famous aqueduct bridge of Maintenon is the most magnificent structure of the kind in the world. Finally, the waters of the plateau between Versailles and Rambouillet were collected and led by channels 98 miles in length through the city.

Constantinople brings its water through valleys and by aqueduct from the valley of Belgrade, a distance of 15 miles.

The difficulties encountered by Glasgow were almost insurmountable. The beautiful scenery about Loch Katrine, was made generally known by Sir Walter Scott, in "The Lady of the Lake." Public attention was directed to the clear waters of the Highland lakes, and their use by the city was suggested. After years of discussion, an Act was passed for tapping Loch Katrine. Water is now conducted

from this lake to the city by built tunnels, mined tunnels, aqueducts and iron pipes. In all, there are seventy tunnels, eight feet in diameter. One of these is 600 feet below the surface. There are twenty-seven aqueducts built over rivers and ravines. Some are of masonry and some of iron. A reservoir with a capacity of 500,000,000 gallons was constructed 26 miles from Loch Katrine, and 7 or 8 miles from Glasgow. Into this the water is first discharged. After undergoing a filtering process, it is conveyed in pipes through the city. It has cost nearly \$9,000,000 to perfect the system.

The famous aqueducts of ancient cities are generally familiar. They are monuments to the skill required to overcome difficulties which have stood across the path leading to wholesome water. Of the two principal aqueducts of Rome, the Aqua Claudia received its waters from the Sabine Hills, 35 miles from the city, and the Anio Novus from the River Anio, 62 miles distant.

The early Greeks depended upon natural springs and cisterns hewn in the rock, but the insufficiency of the supply led to daring engineering works. As early as 625 B. C., a tunnel 4,200 feet long 8 feet broad, and 8 feet high was cut through a hill, which stood between Samos and a coveted source of supply. Fifty or sixty years later, extensive works of a similar nature were constructed to bring water to Athens from the hills of Hymettus, Pentelicus and Parnes. Two conduits from Hymettus passed under the bed of the Ilissus, and were cut in the rock for most of the distance. This conduit and one from Pentelicus met in a large reservoir just outside Athens, and from this the water was distributed throughout the city by underground channels. Some of the ancient aqueducts continue to supply Athens to the present time.

These are a few examples of the exacting conditions encountered by large cities. In striking contrast is the ease

with which Chicago turns to an endless supply at arm's length, with no serious obstacle to overcome.

Lake Michigan, from which Chicago derives its water, is the second in size in the group of the Great North American lakes. Its mean latitude is 44 degrees north. Its length is 320 miles, and maximum breadth 80 miles. Its greatest depth is 840 feet. Although its surface is 594 feet higher than the surface of the sea, at the bottom it is 246 feet below the surface of the sea. The area of Lake Michigan is 26,000 square miles, and its basin about 43,000 square miles, a total area of 69,000 square miles. The lake is supplied by rainfall and the small streams which empty into it on every side, and its outlet is through the Straits of Mackinaw into Lake Huron.

Chicago is located on the southwestern shore of Lake Michigan. Its original site was low and flat, only a few feet above the level of the lake. The Chicago river, with its two branches, separates the city into three divisions. This comparatively insignificant stream is the remnant of a great outlet from the lake to the westward, which once discharged into the Mississippi river. As the waters of the Great Lakes receded, a ridge of limestone rock, nearly parallel with the western shore of Lake Michigan, and 12 to 20 miles distant, rose above their surface and created the watershed separating the basins of the St. Lawrence and the Mississippi. The Chicago river then began to drain the ponds and the swamps which successively appeared on the eastern slope and turned its course toward Lake Michigan.

By artificial means the river has been made to turn backward much of the time since the city has had a population of 300,000, and has become an open sewer. Spring floods and heavy rains frequently counteract the work of pumps, and the sluggish current has been first to the east and then to the west. The so-called stream is usually a stagnant bayou. It has been the source of much annoyance and has

endangered the health of the people. The city's first rude sewers, constructed of planks, and even the open gutters along the streets, emptied into the river ; so have nearly all of the more systematic sewers ever since. There has never been sufficient means to lift the sewage above the ridge which separates the river from the old outlet to the southwest, and the result has been an almost constant discharge of sewage into the lake.

If the conditions could have remained as nature planned them, Chicago's water supply would never have been contaminated. When the city was small, the inhabitants were not troubled ; a little sewage did not affect so large a body of water. As the city expanded, this method of sewage disposal became an evil, too great to be ignored. But the plan could not be easily changed, and the city has gone on ever since in a sort of blind fatuity, trying to convince itself the situation was not serious. Spasmodic efforts were made to cleanse the river when self deception was no longer possible. These efforts have failed to secure permanent relief.

CHAPTER II.

QUALITY OF THE WATER OF LAKE MICHIGAN.

There is no absolute standard by which to test the organic purity of water. Dr. Smart says that the presence of organic substances can easily be detected in most waters, for there are few which are organically pure, but that there is no royal road to an estimation of the quantity, nor to an appreciation of the quality. "The examination must consist," he says, "in instituting a series of experiments on the organic matter, or the substances which accompany it in the water, and on those derived from it. These various witnesses are, as it were, interrogated, and from a consideration of their testimony an opinion is formed as to the quantity of the organic contamination, as to its origin in the animal or vegetable kingdom, as to its source, whether near or remote; in a word, as to the wholesomeness or the unwholesomeness of the water which contains it."

The chemist may be able to estimate the proportions of free and albuminoid ammonia, of nitrates and nitrites which a water contains, and the bacteriologist to count the number of micro-organisms in a cubic centimeter of water, but the figures either will give can have no more than a relative value. There must be taken into consideration the source of the contamination, the conditions under which the samples examined were secured, and the uses to which the water will be put. There are traces of richly carboniferous matter in the waters of Loch Katrine, taken up from the peat of the surrounding hills. The waters of all the Highland lakes contain large quantities of both free and albuminoid

ammonia. And yet both are drunk with impunity. Bacteria, algæ, infusoria and allied organisms are usually found in the waters of lakes in wooded districts, but their presence is not an infallible indication that the water is unfit to drink.

Undecomposed organic matter, if not poisonous, may exist in water without producing harmful results on those who drink it. If decomposed, it may cause a temporary disarrangement of the stomach, resulting in headache, fevers and diarrhœa. The real danger from contamination by organic matter lies in the possibility, or probability, that such organic matter is maintaining bacterial life. The fact of decomposition is evidence of the existence of micro-organisms of some kind.

Bacteria are classified as saprophytic and pathogenic. The former are the cause, or the medium, of fermentation and decay; the latter, of specific diseases. To saprophytic bacteria are to be charged the offensive odors which accompany the decomposition of organic matter, whether in contaminated water, sewage, or elsewhere, and which are not seriously harmful in themselves; to pathogenic bacteria are to be attributed those diseases, contagious or epidemic, which result from the use of polluted water. No analysis of water is complete until the presence or the absence of disease-producing bacteria has been absolutely determined. But it is generally safe to assume that, of the bacteria found in water contaminated by sewage, a greater or less proportion are pathogenic. Of them it is said: "Pathogenic bacteria are not believed to grow and develop outside the animal body. They are, however, known to exist for great lengths of time after leaving the body. And it is found that the conditions under which saprophytic bacteria exist and develop, namely, in decaying organic matter, are at least conducive to the existence of the disease germs. Hence, although in a particular water it may be impossible

to discover or isolate a definite species of pathogenic bacteria, yet the presence of organic contamination, especially of animal origin, or of bacteria in greater numbers than should be expected in a normal water, is regarded as an important reason for its prompt rejection."

A complete analysis of water requires investigation by the microscopist, the chemist and the bacteriologist. Ordinarily, tests by the chemist and the bacteriologist are sufficient; those of the chemist generally are, if the sources of the supposed contamination are known. It may be assumed that pathogenic bacteria will be found in water which contains food for them. The presence of this food is indicated by the ammonias and nitrates. It is the work of the chemist to discover these compounds. The results of his investigations are commonly expressed in the number of parts each of free ammonia, albuminoid ammonia, nitrates and nitrites in 1,000,000 parts of water. The analysis may also show the amount of chlorine in the water, which suggests a possible pollution by sewage, the latter always containing salt. But salt may come from other sources. The amount of oxygen a given quantity of water will consume, is a measure of the present decomposition of the organic matter in the water, and is often determined.

Free ammonia and albuminoid ammonia indicate different stages of decomposition. But ammonia does not long remain in this form in water, as it is either assimilated by living plants, or is converted by the action of bacteria into nitric acid. Uniting with sodium or calcium, this acid exists in water as nitrates of these bases. The nitrates indicate the complete oxidation of other forms of organic matter. The nitrites simply contain less oxygen than the nitrates. In a word, the degree of contamination of water may be determined approximately by the proportion in it of these different forms of organic nitrogen. Since there is no absolute standard for the determination of the purity of water,

the best that can be done in an examination is to investigate the sources of supply and compare the results of analyses with those of waters of known wholesomeness.

The most exhaustive examinations of water supplies in this country have been made by the State Boards of Health of Massachusetts and Connecticut. The Massachusetts Board was the pioneer in this work, but the Connecticut Board has produced equally authoritative results. Investigations relating to the pollution of streams were begun by the Connecticut Board some years ago and were afterward considered of such value that the State Legislature made special appropriations for their continuance. Results are published in the Fourteenth Annual Report of the Board, issued in 1892. Samples of water were taken regularly each month from the reservoirs of several cities, for a period of twenty-three months. These samples were subjected to microscopical, chemical and bacteriological examinations. The public water supplies of these cities are derived from lakes in the interior of the state, and, so far as possible, from those located in wooded and inaccessible districts. The conditions are such that the danger of contamination should be reduced to the minimum, and in these waters should be found a fair standard of wholesomeness.

Supplies were examined by the Connecticut Board's experts, which covered the widest possible range, and are said to have included as large a proportion of the population as practicable. So far as a comparison of these waters with those of Lake Michigan is concerned, it is not necessary to refer to the results of the microscopical examinations, since the really deleterious contaminations are shown by the chemical tests. But it is of interest to note that the microscope never revealed such an abundance of minute vegetable forms in Lake Michigan, as are found in the public water supplies of Connecticut. Dr. Williston, chemical expert for the Connecticut State Board of Health, said of the Thomas-

ton supply: "The water, as received in September, 1889, showed a decided greenish tinge, and the unfiltered water gave the enormous number of nearly 200,000 organisms in the cubic centimeter, or nearly 100,000,000 in an ordinary glassful of water." Of the Connecticut supplies in general he said that, on the average, about 7,000 plants and animals, aside from the bacteria, are swallowed with every glassful of reservoir water that was drank.

Although it may be conceded that the water of Lake Michigan, beyond the reach of sewage contamination, is incomparably pure, the water drawn from the hydrant is known to be more or less polluted. The hydrant water was never in a worse condition than during the season of 1885 and 1886. At that time a series of examinations was made for the Illinois State Board of Health, by Professor John H. Long, a member of the Faculty of the Chicago Medical College. The results were published in the Ninth Annual Report of the Board. Besides a chemical examination of water from a hydrant in the Chicago Medical College building, at Twenty-sixth street and Prairie avenue, on Saturday of each week from September 5, 1885, to August 28, 1886, daily records were made of the changes in the lake level, of the level of the water in the canal lock at Bridgeport, and of the temperature, rainfall, and movement of the wind. Chemical examinations were also made of the Lake View, Hyde Park and Evanston water supplies during a portion of the same period. Similar chemical examinations were made of samples of canal water collected at Bridgeport and Lockport, of canal and Desplaines river water at Joliet, and of Illinois river water at Ottawa and Peoria. The purpose of these examinations was to determine "the rate of oxidation of sewage and the consequent purification of the contents of the canal." There were 152 chemical examinations, 880 water measurements, and 1,760 meteorological observations.

Dr. John H. Rauch, then secretary of the State Board of Health, reports that the conditions existing at the time of these examinations and observations were unusually bad. During the month of August 1885, following a month drier by one-third than the average, there was a rainfall of over $11\frac{1}{4}$ inches, an amount nearly four times greater than the average, and more than twice as much as any previous August rainfall on record in Chicago. "On August 2, nearly six inches of rain fell, and the Desplaines river poured through the Ogden-Wentworth ditch into the South branch of the Chicago river, flushing the entire contents of the river and branches,—unusually foul from the sewer accumulations during the previous dry weather,—and the concentrated filth of the South fork, out into the lake. The pumps at Bridgeport were suspended on the 3d, but resumed operations on the 4th, and continued until the 11th, when, it being obvious that they were simply lifting Desplaines water, which, if unimpeded, would flow by gravity down the canal, the pumps were stopped and the gates opened, making the level in the canal and the river the same. Meanwhile, the sewage product of the city was accumulating in the river owing to the high lake level, and, combined with the high temperature, there resulted a more offensive condition than had obtained at any time since the 'deep cut,' was completed. On the 14th, although the Desplaines continued to pour in through the broken dam of the Ogden-Wentworth ditch, the pumps were again started, and, with the entire plant pushed to its utmost, succeeded on the 17th in raising the level in the canal twenty-six inches above the level of the canal; and this, with the reducing flow from the Desplaines, produced a sensible improvement of the main river and South branch which continued until the heavy rain of August 24th and 25th, nearly four inches. This again flushed out the South fork, and, with the Desplaines torrent taxing the full capacity of the canal, the filth of the South

fork and the contents of the river were again poured into the lake. The pumps were stopped on the 27th, not resuming until September 4th. At this time the flow from the Desplaines river into the South branch through the Ogden-Wentworth ditch was practically unimpeded, and this flow impaired, by so much, the effect of the Bridgeport pumps upon the condition of the Chicago river."

The first of the weekly chemical examinations was made on September 5, 1885. The sewage of the city had been flowing into the lake through the river for almost a month. The analyses, therefore, show the water supply at its worst. An average of the determinations for each month is computed from the chemist's reports, and compared, in the table below, with the analyses of the water supply of Hartford, a fair representative of the water supplies of Connecticut, under usual conditions, as well as of the average supply throughout the country. No estimation of the nitrates and nitrites was made in the Chicago analyses, although the amount of oxygen consumed was reported; but the oxygen consumed is not given in the Hartford reports. It is possible, therefore, to compare only the amounts of free and albuminoid ammonia found in each case. For the purposes of comparison this is quite sufficient. The figures show the number of parts of ammonia in 1,000,000 parts of water, the highest figures showing the greatest degree of pollution, the averages indicating the comparative purity of the waters. The samples of the water were collected on the dates given for the Hartford supply. There were weekly examinations of the Chicago supply, and the figures opposite each date are the average for the month.

CHICAGO WATER SUPPLY.			HARTFORD WATER SUPPLY.		
Date 1885	Free Ammonia	Albuminoid Ammonia	Date 1889	Free Ammonia	Albuminoid Ammonia
Sept. 26	.0105	.085	Aug. 5	.016	.240
Oct. 31	.0042	.078	Sept. 2	.012	.142
Nov. 28	.0047	.074	Oct. 5	.020	.142
Dec. 26	.0047	.088	Nov. 2	.016	.122
1886			Dec. 2	.020	.110
Jan. 30	.0127	.090	1890		
Feb. 27	.0175	.079	Jan. 7	.022	.078
Mar. 27	.0047	.073	Feb. 3	.024	.100
Apr. 24	.0037	.079	Mar. 3	.006	.086
May 29	.0012	.079	Apr. 1	.016	.092
June 26	.0005	.068	May 1	.032	.098
July 31	.0023	.067	June 2	.024	.168
Aug. 27	.0018	.068	July 3	.020	.164
Averages	.0057	.077		.019	.129

These figures show that the Chicago water supply, in its worst possible condition, contained far less organic matter than the Hartford supply in its average condition. But organic pollution of the Chicago supply is the result of sewage contamination which is by no means constant. Unfortunately no systematic examinations of the water of Lake Michigan, beyond the point of possible shore contamination, or of water drawn from the city hydrants when in its best condition, microscopical, chemical or bacteriological, have ever been made. For practical purposes the figures given are sufficient to establish the truth of the statement that the Chicago water supply, bad as it is, is preferable to that of the average city.

Wanklyn says: "If a water yield 0.00 parts of albuminoid ammonia per million, it may be passed as organically pure, despite of much free ammonia and chlorides; and if, indeed, the albuminoid ammonia amount to .02, or to less than .05 parts per million, the water belongs to the class of very pure water. When the albuminoid ammonia amounts to .05, then the proportion of free ammonia becomes an element in the calculation; and I should be inclined to regard with some suspicion a water yielding a consid-

erable quantity of free ammonia along with more than .05 parts of albuminoid ammonia per million. Free ammonia, however, being absent, or very small, a water should not be condemned unless the albuminoid ammonia reaches something like .10 per million. Albuminoid ammonia above .10 per million begins to be a very suspicious sign; and over .15 it ought to condemn a water absolutely."

When at its worst the water of Lake Michigan does not belong to the class which Professor Wanklyn would "be inclined to regard with some suspicion."

The sources of Hartford's water supply are storage reservoirs and the Connecticut river, but water from the river was not used during the period of the examinations referred to in the table. The reservoirs are situated five or six miles west of the city, and have an aggregate capacity of 1,270,000,000 gallons. The water is collected from small streams and adjacent basins, the total area of which is about eleven square miles. The basins are rocky pasture and woodland, and are said to be quite free from house drainage. The population of the city of Hartford is about 53,000, and the average daily consumption of water is 5,000,000 gallons.

In the Illinois State Board of Health Report, containing Professor Long's figures, Dr. Rauch notes the relations between the excessive discharge of sewage into Lake Michigan and the excessive impurity of the water supply as shown by the analyses, and the slight discharge of sewage into the lake and the better condition of the water. The greatest contamination was during the week ending February 27. About the 7th of the month thawing weather set in, with light rainfalls. The Desplaines river overflowed, the ice and snow of its basin having melted rapidly, and the Bridgeport pumps were idle most of the month, unable to counteract the strong current lakeward. The combined effect of these causes, aided by the direct discharge of sew-

age and storm water into the lake, was apparent in the chemical determinations, the free ammonia figures being higher than at any time during the previous seven months.

The best results were obtained from May to August, when the conditions were reversed. The pumps were able to counteract the outward flow, and little sewage found its way into the lake, except from the sewers along the shore. "The observations of these four months demonstrate," says Dr. Rauch, "that the sewage of Chicago can be prevented from polluting its water supply, and that when this is done the city has the best supply; all things taken into consideration, of any large city on the continent, if not in the world."

Under the natural conditions found in Lake Michigan, a great lake is the best possible source of a water supply. Such a lake is a vast settling reservoir, in which the changed constituents of the impurities that find their way into it are precipitated. Through the changes of temperature in this climate and the action of the wind, constant currents are maintained throughout the entire body of water. Aiding these forces is the action of the inflowing streams and of the outflowing excess. The waters of a great lake are said to be thoroughly mixed once a year. A sufficient evidence of the natural purity of the waters of Lake Michigan is found in its characteristic blue color.

Spring waters are imported and used in Chicago in large quantities, in the belief that they are free from the impurities found occasionally in the water of Lake Michigan, the result of sewage contamination. That the latter does contain these impurities in a greater or less degree, with a large proportion of the city's sewage flowing into the lake, there is no doubt. But the imported spring waters are far from pure. In bacteriological examinations made in December, 1892, by Professors Belfield and Haines, of Rush Medi-

cal College, bacteria were found in a spring water brought from Wisconsin, and extensively used in Chicago. Bacteria were also found in water drawn from a local hydrant, and from samples of ice. A sample of artificial ice contained no bacteria.

CHAPTER III.

CHICAGO'S WATER SUPPLY SYSTEM.

Chicago obtained its first water supply from wells. These were dug in the sand which had been heaped up by the winds, or in the silt deposited by the receding waters of the lake. Acting as a great filter bed the sand might have kept the water free from pollution, had there not been an impermeable stratum of blue clay near the surface. In spite of serious contamination the wells were used for twenty years after Chicago was incorporated as a village, although they were not the only source of water supply.

To understand how the wells became unfit for use, a reference to the geological structure of the region embracing Chicago is necessary. The underlying rock is Niagara limestone. Upon this rests the blue clay, whose average depth is about 100 feet. Lake Michigan formerly extended to the ridge already referred to as the watershed of the St. Lawrence and Mississippi basins. As the underlying rock comes to the surface at the ridge, so the clay stratum thins out at the rim. When the lake receded, sand banks, or dunes, were formed across the basin, which extended from the bluffs at Winnetka southward twenty or thirty miles. Between these ridges of sand there were formed inland lakes or ponds in which a luxurious vegetation sprang up. From the resulting decay came the vegetable mold which lies on the surface in some places within the city limits. It is upon this bed of sand and vegetable mold with blue clay beneath that the city of Chicago stands. At no place was the original level more than twelve feet above the lake. It was the

custom when Chicago was a village, as in small villages everywhere to-day, to dig both the well and the vault on the same lot. The wells were never more than twelve feet deep, and usually six. The seepage from the vaults moving freely over the surface of the clay was naturally toward the wells. No health statistics were kept, but there were epidemics which were believed to be expressions of divine wrath. Dr. A. S. Martin, an early resident of Chicago, wrote to *The Sanitary News* in 1884: "The water supply was taken from wells sunk on individual premises, or on vacant lots,—sometimes in the streets. Dish-water, wash-water, and all fluid refuse from the kitchen, were generally thrown on the ground in back yards. In time, the water drawn from the wells began to taste,—a little brackish at first, then saltish, and finally it had a perceptible odor, which ultimately became offensive. A well, at length, had the odorous characteristics of a privy vault. When it rained, the water in well and privy vault rose accordingly; unless the prudent householder 'banked' the latter it often overflowed.

"The disuse of wells brought into existence a new enterprise, that of hauling water from the lake and selling it. A hogshead mounted on an axle between two wheels and drawn by a horse was first used. The only opening was a hole at the top sufficiently large to admit a pail. The vehicle was backed into the lake until the water came conveniently near the top, when the hogshead was filled by the use of pails. The driver then proceeded up the street, mounted on a cross-piece in front of the hogshead, and served those who hailed him with water at a shilling per barrel. The use of the pail in emptying was finally superseded by a hose, tacked around a hole about four inches in diameter near the bottom. At length contracts were made and many families were supplied on certain days of each week, or every other week.

“When Chicago became a city, water works were established just south of the south pier. Although primitive, they answered the purpose for which they were intended very well. I think the mains were originally of wood, and were tapped by lead pipes. At times they would fail, when the water carriers would have a harvest. As the system was extended, iron mains were laid along the principal streets. Various devices were tried; some failed, others succeeded. On the whole, the people of the Garden City made very little complaint.”

Official action was taken on November 10, 1834, to supply the people of Chicago with water. The village council appropriated \$95.50 for digging a public well at the corner of Cass and Michigan streets. This well supplied only a small colony on the North side; persons living on the South side continued to draw water from their individual wells, or to buy it from the water purveyors. Water cart owners found their business a lucrative one, and a company was organized. Water was taken from the lake at the foot of Van Buren street, and supplied by carts as late as 1846.

But the lake was often tempestuous and it was impossible to fill the carts. The resulting dissatisfaction and hardship among the inhabitants prepared the way for a pumping system. The Chicago Hydraulic company was incorporated by special Act of the Legislature on January 18, 1836. The disastrous panic of 1837 checked the company's plans, and work was not fairly begun until 1840. The company's charter permitted it to operate a mill. The combined mill and water works were located at the present intersection of Michigan avenue and Lake street, then directly on the lake shore. An inlet pipe was laid on a crib-work foundation and extended out into the lake about five hundred feet. The pipe was of cast iron, about fifteen inches in diameter, turned downward at the lake end five or six feet. At the shore end was a tank with a capacity of five or six hun-

dred barrels, raised above the ground a few feet by a block foundation. This slight elevation created the only pressure in the distributing system. The works were equipped with a 25-horse power engine and pump to draw the water from the lake to the reservoir, and about two miles of rude wooden pipe were laid. The sections of the pipe were pine logs, bored out by hand and strapped with hoop iron. The mains were six inches in diameter and were laid in the alleys about three feet below the surface. Remnants of these pipes have been unearthed from time to time, the latest when the foundations were dug for the new Chamber of Commerce building in 1889.

This primitive system supplied only a limited portion of the South division with water. Notwithstanding its apparent advantages, it is said that at least four-fifths of the people living within the corporate limits obtained their water for domestic use from the river or by water carts from the lake. In a reminiscent lecture delivered in McCormick Hall, on January 23, 1876, Governor Bross said : "In 1848, Lake and Water, and perhaps Randolph streets, and the cross streets between them east of the river, were supplied from logs. James H. Woodworth ran a grist mill on the north side of Lake street, near the lake, the engine for which also pumped the water into a wooden cistern that supplied the logs. Whenever the lake was rough the water was excessively muddy ; but in this myself and family had no personal interest, for we lived outside the water supply. Wells were in most cases tabooed, for the water was bad, and we, in common with perhaps a majority of our fellow citizens, were forced to buy our water by the bucket or the barrel from water carts. This we did for six years."

The Hydraulic company does not appear to have made money out of its venture, but it maintained an existence until February 15, 1851, when the Legislature, again by

special Act, incorporated the Chicago City Hydraulic company. The indifference of the people was shown at the spring election. Of the 4,445 voters, 513 cast their ballots against the acceptance of the privilege granted by the Legislature, and 1,244 did not vote on the question at all.

Dr. John H. Rauch, first secretary of the State Board of Health, says, in his Second Annual Report, that the effect of drinking well water was so marked during the prevalence of cholera in 1849 and 1850, compared with that of drinking lake water supplied to a few inhabitants by the Hydraulic company, this was one of the reasons urged for the incorporation of the City Hydraulic company. Concerning the contamination of the wells during the cholera epidemic, it was observed that nearly all who drank the water of a certain well on North LaSalle street died. This attracted attention, and was supposed to be owing to the fact that the well received the drainage from privies in the neighborhood, and in this way infected those who drank the water. This was true. But Dr. Rauch discovered afterward that, in this neighborhood, the soil was stratified with thin layers of blue clay, which was impervious to water, and whenever these layers were penetrated by wells, they acted as drains for a great area, the remaining portion of the soil being composed of sand until the thick stratum of blue clay underlying the greater portion of the city was reached.

There was some dispute as to the right of the city to encroach upon the privileges of the old Hydraulic company, and satisfactory terms could not be made with it until the year following the incorporation of the company. The city then began the construction of its own works, which were put in operation in February, 1854. This was the beginning of the present system. Authority over the works was vested in a Board of Water Commissioners. The first board consisted of John B. Turner, A. S. Sher-

man and H. G. Loomis. The pumping works were located on the lake shore at the foot of Chicago avenue. Already the discharge of sewage into the lake from the river had caused annoyance, and an alternative location for the pumping works at a considerable distance south of the river was suggested. In recommending the site chosen, Chief Engineer J. McAlpine said: "It is very questionable whether the small quantity which is discharged from the river would affect the quality of the water in the lake at a point $1\frac{1}{2}$ miles south. From the consideration which I have given the subject, I am of the opinion that there is no perceptible difference between the quality of the water in the lake above the pier and that at the place $1\frac{1}{2}$ miles south of the river, on which the estimates have been predicated."

The water was taken from an inlet basin on the lake shore, separated from the lake by a semi-circular break-water with an opening to the southeast, and distributed through three reservoirs, serving the three divisions of the city, situated, respectively, at LaSalle and Adams streets, Chicago avenue and Sedgwick street, and Morgan and Monroe streets. The first two were built in 1853, and the latter in 1854. Each held about two or three days' supply. The first iron distribution pipe was laid in Clark street in 1852, and was four inches in diameter. To keep the three reservoirs filled it was necessary to operate the pumps about twelve hours a day. The use of these reservoirs was discontinued after the completion of the West side tunnel in 1874.

In a sketch of the water supply system, written in 1876, Chief Engineer Chesbrough says that the increased growth of the city after the inauguration of the water works, and the introduction of sewerage, together with the establishment of the packing houses, distilleries, etc., so increased the quantity of filth discharged into the lake, that complaints began to be made of impurity and offensiveness in the supply from

the pumping works. Governor Bross, in the address referred to on a preceding page, spoke of the new works, and added: "But our troubles were by no means ended. The water was pumped from the lake shore the same as in the old works, and hence, in storms, it was excessively muddy. In the spring and early summer it was impossible to keep young fish out of the reservoir, and it was no uncommon thing to find the unwelcome fry sporting in one's washbowl, or dead and stuck in the faucets. Besides, they would find their way into the hot water reservoir, where they would get stewed up into a very nauseous fish chowder. The water at such times was not only the horror of all good housewives, but it was justly thought to be very unhealthy. Worse than all this, while at ordinary times there is a current on the lake shore south, and the water, though often muddy and sometimes fishy, was comparatively good; when the wind blew strongly from the south, often for several days, the current was changed and the water from the river, made from the sewage mixed with it into an abominably filthy soup, was pumped up and distributed through the pipes alike to the poorest street gamin and to the nabobs of the city."

In 1859, Mr. Chesbrough relates, one of the water commissioners, Mr. Edward Hamilton, proposed to sink a wrought iron pipe, five feet in diameter, one mile out into the lake, to obtain the supply from a point which could not be affected by the river. This plan was referred to the chief engineer of the Board of Sewerage Commissioners, Mr. Chesbrough himself, to be examined and reported upon, with the request "that he also take under consideration and report on the matter of erecting additional pumping works, in such locality as shall secure a supply of pure water." In his report Mr. Chesbrough discussed several plans, but made no specific recommendation. A tunnel was suggested, but it was thought best to defer action until there could be

further expert examination of the water, in the hope that much of the complaint was without foundation.

But the water continued to grow worse and became very offensive both to the taste and smell. The Board of Public Works, created in 1861, discussed the various plans proposed for relief and experimented with filters, which were soon found inadequate. "The engineer of the Board, after much doubt and careful examination of the whole subject, became more inclined to the tunnel plan than any other, as combining great directness to the nearest inexhaustible supply of pure water, with permanency of structure and ease of maintenance. The possibility, and, in the estimation of many, the probability of meeting insuperable difficulties in the nature of the soil, or storms, or ice on the lake, were fully considered. One by one the objections appeared to be overcome, either by providing against them, or discovering that they had no real foundation." When the plan was so far worked out as to show how the tunnel could be constructed it was submitted to several skilled engineers, all of whom expressed their belief in the practicability of the scheme. The president of the Board of Public Works supported the plan, but the two other members of the Board were very cautious and doubtful at first. It was not until a new Board was elected and more thorough examinations of the soil were made that the project was recommended to the Common Council. At length, the necessary ordinances were passed and the Board advertised for bids.

"The opening of the proposals," says Mr. Chesbrough, "was looked to with great interest, as it was feared that no responsible parties would offer to take the work for less than millions, instead of only about \$300,000, the engineer's estimate, in which not only the public generally but the Board of Public Works themselves had no great confidence. The result was both surprising and gratifying to

the Board. Seven bids were received, ranging in amount from \$239,548 to \$1,056,000. Owing to failure to appear with sureties at the proper time, and to objectionable conditions, the two lowest bids were rejected." After considerable inquiry as to the financial responsibility of the bidders a contract for the construction of the tunnel was entered into with J. J. Dull and James Gowan of Pennsylvania on October 20, 1863. On the evening before the date of the contract an attempt was made in the Common Council to repeal the ordinance authorizing the contract, on the ground that the proposed crib would be a permanent obstruction to navigation. The Board of Public Works agreed to lower the crib to such a depth below the surface of the lake that it would not interfere with navigation, if it should prove to be necessary, and the repealing ordinance did not pass.

Ground for the tunnel was broken on March 17, 1864. The plan of the work included a land shaft at the western extremity of the tunnel at the foot of Chicago avenue, and a lake shaft at the eastern extremity. The tunnel was to be two miles in length, extending in an east-northeasterly direction from the pumping works. The horizontal diameter of the tunnel was fixed at five feet, and the vertical at five feet and two inches. Mr. Chesbrough says this size was determined upon for two reasons: It was sufficient to deliver a supply for one million inhabitants at the rate of fifty gallons a day for each person, the average quantity used at that time; and experience in Europe had shown that, while it was possible to make small tunnels in the most troublesome ground, the attempt to make large ones had sometimes failed, and at others had been attended with enormous difficulties. "Although there was every reason to expect easy work here, there was a possibility of meeting deposits of quicksand, or other soft, wet material. In order to remove as far as practicable every doubt of the

final success of the work, this small size was adopted, in the full conviction that whenever it should prove insufficient to supply the demand upon it, the population and wealth of the city would be abundantly able to construct another, and, if necessary, a larger one."

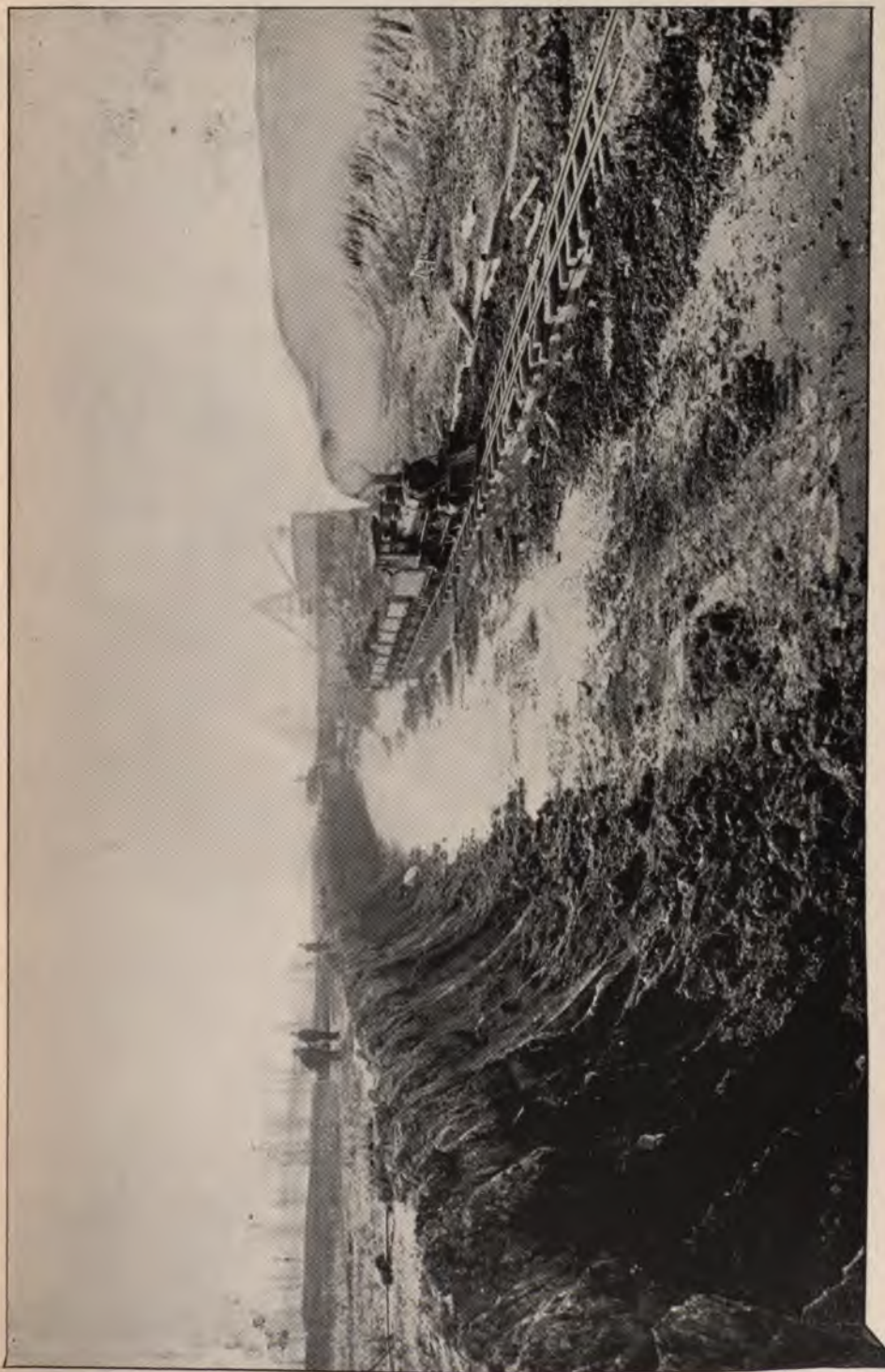
The tunnel was completed substantially as planned, and the last stone was formally laid on December 6, 1866. The contract price was \$315,139. The final settlement was for \$380,784.60, including \$27,420 for extras on the tunnel proper, and \$41,225.60, for extras on the shaft, crib and east and west connections. The exact length of the tunnel was 10,567 feet.

The system of water-pipe tunnels under the river was originated in 1869. Previous to that time the pipes were laid on the bottom of the river, but the large main crossing the river at Chicago avenue was broken on August 18, 1869, by a vessel dragging her anchor. As a result of this accident the West side was without water for three days. The buildings and the water tower, comprising the North side pumping station, substantially as they are to-day, were completed in the same year.

In the great fire of 1871 all the buildings connected with the works, except the tower, were partially destroyed. The machinery was so damaged that pumping was stopped, cutting off the supply of water and leaving the city without the means to protect it from the fire. One of the engines was put in running order eight days after the fire and the others a month later. The water supply system expanded rapidly after this. At the present time there are six pumping stations, as follows: Lake View, on Sulzer street; North Side, on Chicago avenue; West Side, on Twenty-second street; Central, on Harrison street; Fourteenth street, on Fourteenth street; and Hyde Park on Sixty-eighth street. The total capacity of the stations is 305,000,000 gallons. The average rate of supply to each

inhabitant during the year 1891 was 135 gallons. At the same rate the present pumps will supply 2,250,000 inhabitants.

In 1874 a second tunnel, seven feet in diameter, was completed under the lake from the crib to the North Side station. In the same year this tunnel was extended, also seven feet in diameter, under the city to the new West Side pumping station at Ashland avenue and Twenty-second street. There are other tunnels to connect the Central and Fourteenth street pumping stations with the West Side tunnel. In 1887 a shore inlet tunnel, seven feet in diameter and 1,500 feet long, was extended under the lake opposite the North Side pumping station, to be used when the supply at the two-mile crib should be endangered by ice or otherwise. This tunnel was seldom used until the latter part of 1891. In November of that year a new tunnel, planned to be eight feet in diameter, but which was made double and six feet in diameter for a part of the distance, was completed. It extended out under the lake four miles from the foot of Peck court. It was opened in November, 1892, and gave the city an ample supply of wholesome water. The use of the shore inlet tunnel was then discontinued.



CHAPTER IV.

METHODS OF SEWAGE DISPOSAL.

The decomposition of waste matter is due to the action of certain micro-organisms known as bacteria. Organic waste is their food. But it is necessary that they be supplied with oxygen, and to this extent oxygen is an important factor in decomposition. By the action of these invisible organisms organic matter, whether of animal or vegetable origin, is broken up into its original elements, or harmless compounds. The products are ammonia, ammonia compounds and nitrates, or other compounds of a mineral nature. The former constitute the fertilizing material, for the economical extraction of which from sewage every conceivable process has been unsuccessfully tested. So necessary are these invisible forms of life in this work that it has been proposed they should be specially cultivated and turned into sewage. But they are usually present when needed, ready to begin their work of destruction if supplied with oxygen, without which they are at first inert and then lifeless.

The study of micro-organisms is interesting and important because of the vital part they play in the life of man, both in sickness and in health. In the operations of these minute beings a new world is brought to light. Their number, even in a defined space, is inconceivable. In a single gramme of butter, so much as can be held on the point of a knife, there are said to be 2,465,555 micro-organisms, when the butter is taken from the center of the roll, and as many as 47,250,000 when taken from the outside.

M. Cohn, a French botanist of distinction, gives this graphic description: "Almost all the bacteria possess two different modes of life, characterized by repose and movement. In certain conditions, they are excessively mobile; and when they swarm in a drop of water, they present an attractive spectacle, similar to that of a swarm of gnats, or an ant-hill. The bacteria advance, swimming, then retreat without turning about, or even describe circular lines. At one time they advance with the rapidity of an arrow; at another they turn upon themselves like a top; sometimes they remain motionless for a long time and then dart off like a flash. The long rod-bacteria twist their bodies in swimming, sometimes slowly, sometimes with address and agility as if they tried to force for themselves a passage through obstacles. It is thus that the fish seeks its way through aquatic plants. They remain sometimes quiet, as if to repose an instant. Suddenly the little rod commences to oscillate, and then to swim briskly backwards, again to throw itself forward some instants after. All these movements are accompanied by a second movement analogous to that of a screw which moves in a nut. When the vibrios in the shape of a gimlet turn rapidly round their axis, they produce a singular illusion; one would believe they twisted like an eel, although they are extremely rigid."

Magnin says: "The bacteria are of all beings the most widely diffused. We meet them everywhere,—in the air, in the water, upon the surface of solid bodies, in the interior of plants and animals. If we expose a transparent liquid containing traces of organic substances, we find after a short time that it has become clouded, and the microscope shows us that it contains myriads of these beings. . . . So long as the bacteria find the necessary aliment, in sufficient quantity, to form new protoplasm, they multiply with activity; but as soon as the organic matter is devoured, they cease to divide, fall to the bottom of the vessel, where

they accumulate, motionless, and form a deposit more or less abundant."

Cohn, assuming that a bacterium divides into two in the space of an hour, then into four at the end of the second hour, then into eight at the end of three hours, makes this computation: "In twenty-four hours the number will already amount to more than 16,777,220; at the end of two days this bacterium will have multiplied to the incredible number of 281,500,000,000; at the end of three days it will have furnished 47,000,000,000,000; at the end of about a week, a number which can only be represented by fifty-one figures. In order to render these numbers more comprehensible, let us seek the volume and the weight which may result from the multiplication of a single bacterium. The individuals of the most common species of rod-bacteria present the form of a short cylinder, having a diameter of a thousandth of a millimeter in length. Let us represent to ourselves a cubic measure of a millimeter. This measure would contain, according to what we have just said, 633,000,000 of rod-bacteria without leaving any empty space. Now, at the end of twenty-four hours the bacteria coming from a single rod would occupy the fortieth part of a cubic millimeter; but at the end of the following day they would fill a space equal to 442,570 of these cubes, or about half a liter. Let us admit that the space occupied by the sea is equal to two-thirds of the terrestrial surface, and that its mean depth is a mile, the capacity of the ocean will be 928,000,000 cubic miles. The multiplication being continued with the same conditions, the bacteria issuing from a single germ would fill the ocean in five days."

"En resume," says Magnin, "the little beings which we have been considering have an important role; they cause the return of dead organic matter to the atmosphere and to water."

"Without them," according to Duclaux, "organic mat-

ter, even exposed to the air, would not be destroyed, or would be transformed with extreme slowness, in consequence of a slow combustion produced by oxygen. With them, on the contrary, its destruction takes a rapid march and becomes complete. If, then, the equilibrium is maintained between living nature and dead nature, if the air has always the same composition, if the waters are always equally fertilizing, it is thanks to the infinitely minute agents of fermentation and putrefaction."

The utilization of micro-organisms in the purification of sewage has been tested by Mr. W. E. Adeney, curator in the Royal University of Ireland, and Mr. W. Kaye Parry, of Dublin. Mr. Adeney undertook to determine how much oxygen was required to support the micro-organisms while a given amount of sewage was decomposed. Having removed the solids, a given volume of sewage was mixed with water in different proportions. The mixture was poured into bottles which were kept at a temperature of about 60° Fah., from seven to thirty days. The nature and the extent of the changes in the organic matter were determined by estimating the quantities of ammonia, nitrous and nitric acids, organic carbon and dissolved gases before the bottles were sealed and after they were opened. "It was found," as reported by London *Engineering*, "that the variation in results was entirely due to the quantity of oxygen originally present in the different mixtures, the oxygen being introduced in the water." In the mixtures containing 1 part of sewage to 99 of water, and down to 79, a decided quantity of oxygen remained unabsorbed, while the organic matters were entirely decomposed. There was no evidence afterward of putrefaction. In the mixtures containing 69 to 59 parts of water small quantities of dissolved oxygen were found unabsorbed; only a part of the ammonia had oxidized to nitric acid.

"In the 1 to 49 mixture a trace of oxygen was de-

tected, and none of the ammonia had apparently been oxidized, although the organic matters originally present had been entirely decomposed, the organic carbon and nitrogen having been converted into carbon dioxide and nitric acid respectively, as in all the previous instances. In the 1 to 39 mixtures no free oxygen was found ; practically the whole of the organic carbon had been converted into carbon dioxide, but the organic nitrogen had only been partially oxidized to nitric acid, some being reduced to ammonia. The ammonia originally present had remained apparently unaffected. In the remaining three mixtures no oxygen was detected. The organic matters had not been completely decomposed, and none of the organic nitrogen had been oxidized, but some had been converted to ammonia. Putrefactive fermentation had been set up with very offensive odors. In the mixtures 1 to 19 and 1 to 9 decided quantities of sulphuretted hydrogen were found.

“The lesson of these experiments is very easily learned. The complete decomposition of the organic matters of sewage can only be effected without putrefaction and odor in the presence of an ample supply of oxygen. As the supply is lessened, the ammonia first escapes alteration, then the nitrogen fails to be oxidized to nitric acid, and finally the organic carbon is only partially decomposed. This accords with the contention of some sanitarians that sewage, from which the solids have been precipitated, may be safely turned into a running stream, provided that its oxygen has not already been used up by a similar process in its higher parts, and also that its volume is great relatively to the sewage.”

There are five principal methods of treating sewage : By discharge into the sea, or a large water course ; broad irrigation ; intermittent filtration ; filtration through artificial filters, and chemical treatment, or precipitation. The one that has proved most successful is the discharge into a large and slow-moving stream. The facts briefly cited in pre-

ceding pages show that the purification of sewage does not depend upon artificial treatment, but upon the natural and unimpeded action of living organisms. All that these organisms require is sufficient oxygen to maintain their vitality. The oxygen can be conveyed to them in water used to dilute the sewage. Not only is this method of sewage disposal theoretically correct, but the results have been attained in practice. The inadequacy of the other methods may be noted briefly.

Discharge into the Sea.—This method is naturally adopted by towns upon the sea coast, the tides being relied upon to carry the sewage beyond the line of offense. Notwithstanding special arrangements are made by many cities to discharge the sewage only when the tide is ebbing, much of it is cast back upon the shores before it has reached a sensible degree of purification, and is the source of much annoyance and sickness. Neighboring towns suffer when the discharge is large, and the foul deposits are left upon the coasts to undergo decomposition. "A striking instance is furnished by the case of London, which discharges its sewage into the tidal estuary of the Thames at Barking and Crossness during only some three or four hours from the time of each high tide. It is found that the discharged matter is washed up and down the river with every tide, occasionally reaching as far up as Teddington, and that the portion which is not deposited in the form of mud banks only very slowly works its way to the sea."

Broad Irrigation.—Where the soil is a porous sandy loam sewage may be turned over it and sewage farming carried on. But it requires at least one acre of land for every 120 persons in the sewage contributing district, and a soil and climate which will permit of the discharge of the sewage throughout the entire year. The extent of land required and the expense of the delivery and the distribution of the sewage, if the farms are not in the immediate vicinity, ren-

der this method impracticable for a large city, unless a constant loss in operation is willingly borne. In a climate like that of Chicago, the sewage would become a nuisance in the winter months. When a sewage farm is properly laid out and managed, the effluent water is without odor, and was formerly believed to be pure enough to turn into a stream to be used for a water supply. It has been shown recently that disease germs, which are most to be feared, are not necessarily removed by filtration through the soil, which must be often taxed beyond its capacity.

An illustration of the unsatisfactory method of sewage disposal by broad irrigation, supplemented by intermittent filtration, is found at Pullman, Illinois. The sewage, when the system is in operation, is applied to a farm of 140 acres. Under-drains are laid to carry the effluent water to Lake Calumet. The farm is operated for profit only, and the sewage is allowed to run directly into the lake during the winter. This cannot be long permitted, as the lake is small and will soon become contaminated beyond endurance. What can be done with the sewage during cold and wet weather is still undetermined. Mr. C. A. Allen, city engineer of Worcester, Massachusetts, thus described a visit which he made to the Pullman sewage farm in January, 1887:

“Upon the day of our visit it was quite warm, the thermometer registering 40° Fah. We found that the sewage was being discharged upon the filtration area, the first section of which was covered with sludge to a depth of about a foot. The sewage was running over this, to the second section, which was partially covered with ice, and then over the remaining area, which was entirely covered with ice, and was finally discharged into the effluent trench without having been filtered in the least. The entire area was completely covered with sewage, and there was evidently no filtration taking place, as about the same quantity passed

off at the lower ends of the beds as was discharged upon the upper end. The manager of the farm was away, but we were given the following facts by his assistant, which we subsequently verified:

“The farm is run for the purpose of making money, the purification of the sewage being a secondary condition. During the summer months, when vegetation has received all the sewage it will bear, it is simply turned into Lake Calumet in its crude state. We were told that not a particle of sewage has been applied to the farm proper this winter, it all having been simply passed over the area as already described.”

Mr. Allen Hazen, chemist in charge of the Lawrence Experiment Station of the Massachusetts State Board of Health, visited the farm in October, 1891. He says: “The superintendent was absent, and I was shown about by a man who had worked on the farm for some years. He told me that with the application of sewage worms developed in the soil and destroyed the crops, and for this reason no sewage had been applied for two or three years. Large quantities of horse manure from Chicago stables are applied to the land, but no sewage whatever. After broad irrigation was abandoned, so-called intermittent filtration was tried on ten acres of soil on which no crops were grown. The filter was not in use at the time of my visit, nor did it have the appearance of having been used. My guide thought it was at least a month since any sewage had been applied, and a much longer time since any considerable quantity had been treated. The sewage of the entire town was being turned into Lake Calumet, from which quantities of ice for Chicago are cut.”

In November, 1892, all the sewage was flowing directly into Lake Calumet, and the sewage distributing works were not in use.

Intermittent Filtration.—As shown in the practice at

Pullman, intermittent filtration is generally supplementary to broad irrigation. Dr. Frankland called attention in 1870 to the fact that if sewage were passed through porous soil at intervals, allowing sufficient time for the soil to become aerated, "rapid purification took place through the oxidizing action of the air which the soil held in its pores." The suggestion was taken up by Mr. J. Bailey-Denton, and in his hands the system of intermittent filtration through land is said to have been successfully applied to the sewage of many small towns in England. Its failure at Pullman has already been noted.

Efforts have been made at the so-called Lawrence Experiment Station in Massachusetts for the past two or three years, under the auspices of the State Board of Health, to show that intermittent filtration can be successfully accomplished. In an experimental and limited way, and under the most careful manipulation and favoring circumstances, it seems that sewage can be partially purified by this method. That it is not successful under all the circumstances attending the disposal of the sewage of a town in the climate of Chicago and above the average in size is also shown.

Chemical Treatment, or Precipitation.—If sewage is permitted to stand in or to flow slowly through a large receptacle, there will be a gradual subsidence of the solid particles, but the subsidence is usually so slow that decomposition will set in before it is complete. It may be accelerated by the addition of reagents, which, producing a precipitate, will carry down with them the particles of solid matter that are suspended in the sewage. Lime is the substance usually employed. Mixtures of various substances are also used, but no compound has yet been discovered, whose cost will permit its use, that is effective in removing the organic matter and disease-producing micro-organisms from the sewage.

The sewage of London is intercepted on either side of the Thames, on one side of which it flows twelve miles and on the other fourteen miles before it is discharged into the river. The amount which reaches the river is about 219,000,000 gallons daily. By chemical treatment the deposits from this mass are considerable before it reaches the river. But some recent experiments made by Dr. E. D. Dupre and Mr. W. J. Dibdin, who designed the sewage disposal works of London, have convinced them that no chemical scheme will do more than clarify the sewage and remove a small portion of the dissolved matter. While Dr. Dupre believed the most effective treatment of sewage under ordinary circumstances was by passing it through suitable land, he was convinced that, in the case of London, the river was able to do part of the purification as effectively and less offensively than a sewage farm. That which precipitation may accomplish is the removal of industrial waste products which may be poisonous to vegetable and animal life.

After describing the various precipitation processes, Corfield concludes that they all do to a certain extent purify sewage and prevent the pollution of rivers, chiefly by removing the suspended matters from the sewage, but that they all leave a very large amount of putrescible matter in the effluent water, and at least all the ammonia contained in the sewage, and sometimes add to it. The fertilizing material they produce is in every case very inferior, as might be expected, he says, from the known value of the sewage constituents that can be precipitated. "They have all failed in producing valuable manure, because the valuable constituent of sewage, par excellence, is the ammonia, which of course invariably totally escapes in the effluent water, and is lost to the manure. This shows the futility of all attempts to utilize sewage by precipitation alone."

Pettenkofer declares that sewage is decomposed in running

streams and rendered harmless in the course of a few miles flow. This, he says, depends upon the presence of a large amount of oxygen in water, which he believes to be necessary to the action of green algæ and other forms of water plants. At his request an investigation was made recently by Drs. Pleiffer and Eisenlohr, of the natural purification of the river Isar, which receives the sewage of Munich. Among the forms of vegetable or bacterial life found in water is one known as *Beggiatoia*, sometimes called sewage fungus. Within a mile below the point where the Munich sewage enters the Isar, they found the *Beggiatoia* growing in abundance. It was still found at Ismaning, $7\frac{1}{2}$ miles below, but the last traces of it were found at Garching, 10 miles below. Their inference was that after twelve miles flow the Isar was so purified that its waters would no longer support this plant. Chemical analyses also established the fact of purification. Pettenkofer reports that he found 198,000 bacteria in each cubic centimeter of water at the mouth of the sewer, while at Ismaning there were only 15,231, and at Freising, twenty miles below the mouth of the sewer, the number had been reduced to 3,602.

During the extraordinarily dry season of 1886, the Illinois State Board of Health undertook to determine the rate of purification of the water in the Illinois and Michigan canal. The rainfall was so light during the months of June, July and August, that the contents of the canal from Bridgeport to Joliet were practically unaffected by dilution. Samples of river water at Bridgeport, canal water at Lockport, canal and Desplaines river water at Joliet, and Illinois river water at Ottawa and Peoria, were secured and submitted to Professor John H. Long, for chemical examination. These were the results:

Places	Free	Albuminoid	Oxygen
	Ammonia	Ammonia	Used
	In 1,000,000 parts.		
Bridgeport	26.563	1.633	26.20
Lockport, 29 miles below	12.733	.753	11.01
Joliet, 33 miles below	9.426	.482	7.84
Ottawa, 81 miles below	.413	.243	5.30
Peoria, 159 miles below	.027	.191	4.81

It appears from these figures that more than one-half of the pollution disappeared before the sewage reached Lockport, 29 miles below Bridgeport, and nearly one-third of the remainder in the next four miles. This occurred, too, without such dilution as is now known to be essential to the rapid and harmless purification of sewage. The results suggest conclusions which are in line with those of Pettenkofer and other investigators.

From these facts it is evident that Chicago has now adopted the method of sewage disposal which is most efficient, economical and inoffensive. With a sufficient dilution of the sewage there will be complete purification. This result will be attained by natural processes, necessarily the most successful, and the water of the new drainage channel may be expected to be as clear and pure at and below Joliet as that of the average river.

CHAPTER V.

CHICAGO'S SEWERAGE SYSTEM.

No effort was made to provide Chicago with a system of sewerage until the year 1855. Previous to that time the city was drained by submerged wooden boxes on a few of the principal streets. These were constructed, primarily, to supply water for use in extinguishing fires. They were found to be serviceable in carrying away surplus water from the streets, and were afterward used to a limited extent for house drainage. As they were laid without system and were limited in capacity they were of little use except for surface drainage. In wet seasons they failed to carry away even the surface water.

As a result the city was scourged by epidemics for six years in succession. The death rate became higher than that of any other city in the country. In 1854, with cholera raging, nearly $5\frac{1}{2}$ per cent. of the population died. For the six years beginning with 1849 and ending with 1854, the death rate was 48.92 per thousand. In self defense the city was compelled to consider the construction of an adequate sewerage system. A bill was passed by the Legislature on February 4, 1855, creating a Board of Sewerage Commissioners to be appointed by the City Council. The first Board consisted of William B. Ogden, J. D. Webster, and Sylvester Lind, one from each division of the city. E. S. Chesbrough, then of Boston, was appointed chief engineer. The remainder of the first year was spent in making surveys and preparing plans, which were adopted in December. Work was begun on the sewers in the spring of 1856.

Summarized, the Act creating the commission made these provisions: (1) It shall be the duty of the commissioners to examine and consider all matters relating to the thorough, systematic and effectual drainage of the city of Chicago, not only of surface water and filth, but also of the soil to a sufficient depth to secure dryness in cellars and an entire freedom from stagnant water, and in such manner as best to promote the healthfulness of the city. (2) It shall be the duty of the commissioners, before entering upon the construction of any sewer, to fix upon a plan or system of sewerage of such a nature that all subsequent sewers may be executed upon that plan. (3) It shall be the duty of the Board to prescribe the location, arrangement, form, material and construction of every private drain or sewer emptying into the public drains or sewers, and to determine the manner and plan of such connection. (4) It shall be the duty of the board to see that proper drains or sewers are constructed from every lot in the city, which, in their judgment, requires it, and that such private drains or sewers are made to communicate with public drains or sewers in a proper manner, and they shall have power to require such number of drains or sewers to be thus constructed as they shall deem expedient.

Systematic sewerage in this country was unknown when Mr. Chesbrough was called upon to suggest the best method of complying with the law. Not only was the chief engineer unable to profit by the experience of other cities, but the local conditions were unfavorable. From a sketch written by Mr. W. H. Clarke, principal assistant engineer in 1877, it is learned that when the original surveys for the sewerage system were made, the surface of the ground in the vicinity of the North and South branches of the Chicago river was only three or four feet above the surface of the lake. It rose irregularly eastward, until at Michigan and Rush streets it was from ten to twelve feet above the same

level; to the westward it reached about the same level at Ashland avenue. This configuration made it necessary to raise the grade of the streets to keep the sewers under ground. After considerable discussion it was decided to fill in to a level of ten feet above ordinary water on the streets adjacent to the river, raising them with an inclination sufficient to protect the sewers and to permit the construction of cellars seven to eight feet in height. A higher grade was recommended, but it was argued that there would be difficulty in securing sufficient earth to raise the streets to the minimum height decided upon. A few years later it was found that the surplus earth of the South division was sufficient not only to raise the grade of the streets but to fill up the entire lake basin between the Illinois Central railroad and Michigan avenue. For a number of years after the construction of the sewers began, some of them were partially above ground, and others entirely so, in what are now business districts of the city. In other localities where the ground was high enough to cover the sewers the grades of the street were fixed by cutting out abrupt irregularities. In places where the ground was too low to permit the construction of well-drained cellars the grade was established at such a height above the surface of the lake as to give not less than seven feet in height to the cellars if they were entirely below the surface of the ground, and at a greater height if the principal floor was elevated above the level of the street.

Soon after their organization the sewerage commissioners asked the public for plans and suggestions. Thirty-nine communications were received. Some of them, according to Mr. Chesbrough, were very able and interesting papers. Although none of the plans proposed was adopted, there were many valuable suggestions. Mr. Chesbrough's report to the commissioners was made on December 26, 1855. The plan he proposed was adopted by the board on Decem-

ber 31. It provided for the discharge of the sewage mainly into the river, which, the chief engineer argued, would deliver it well out into the lake. The general arrangement of the sewers placed mains in each of the alternate streets running to the river, or about eight hundred feet apart, into which two-foot brick sub-main sewers in the streets running at right angles were to discharge. The main sewers were from three to six feet in diameter and built of brick, the walls being eight and one-half inches thick.

The original plans provided for the sewerage of what now seems to have been a very small territory. Its southern limit in the South division was Taylor street. In the West division the boundary line ran north on Halsted street to Madison, west to Sangamon, north to Fulton and east to the river. In the North division the district was bounded by Franklin street on the west, Chicago avenue on the north and Rush street on the east. Considerable time elapsed before this limited territory was provided with sewers. Up to the close of 1857, two years after the inception of the work, mains had been built only on Michigan avenue, from Washington street to the river; on Madison street east from Halsted to the river; on Randolph street east from Sangamon to the river; on Clark street south from Chicago avenue to the river, and on Rush street south from Huron to the river. This gave only one main to the South division; two to the West division; and two to the North division. There were sub-mains on Randolph and Washington streets, extending from the Michigan avenue sewer to the river. These have since been converted into main sewers from State street west, discharging into the river, while the portions east of State street still discharge into the Michigan avenue sewer.

Mr. Chesbrough foresaw the evils resulting from the discharge of sewage into the lake. It was impossible at that time to create an outlet to the southwest, but he appears

to have believed that this would be the ultimate solution of the sewerage problem, and his plans were in harmony with it.

The minds of the people were still unsettled as to what should be admitted to the sewers. Sewers were originally constructed to carry off surface water only. Bazalgette says of London sewerage : "Up to the year 1815, it was penal to discharge sewage or offensive matter into the sewers. Cesspools were regarded as the proper receptacles for house drainage, and sewers as the legitimate channels for carrying off the surface water only. Afterwards, it became permissive, and in the year 1847 the first Act was obtained making it compulsory to drain houses into sewers."

As the main object of sewers was to improve and to preserve the health of the city, it was obvious to Mr. Cheshbrough that all substances should be received into them which would have a contrary effect if not drained off. These included all stagnant water, all liquids from kitchens and manufactories, and the contents of vaults. With regard to the vaults, as then constructed and used in most parts of the city, they were abominations that should be swept away as speedily as possible. To construct the vaults as they should be, and maintain them even in a comparatively inoffensive condition, would be more expensive than to construct an entire system of sewerage for no other purpose, if the past experience of London and other large cities was any guide for the future of Chicago.

What should the sewage of the city be drained into? Four principal plans had been proposed: (1) Into the river and branches directly, and thence into the lake; (2) Directly into the lake; (3) Into artificial reservoirs, to be thence pumped up and used as a fertilizer; (4) Into the river, and thence by a steamboat canal into the Illinois river. The first plan had been adopted. The reasons in its favor were that it would allow the sewers to be constructed in

such a manner as to take the utmost advantage of the natural facilities that the site of the city afforded, and, consequently, that the sewerage might be less in extent and cost.

The principal objections were, that it would endanger the health of the city, especially during the warm, dry portions of the year, and that it might fill up the river so much as to obstruct its navigation. It was proposed to remove the first objection by pouring into the river from the lake a sufficient quantity of pure water to prevent offensive or injurious exhalations. The latter objection was believed to be groundless because the substances to be conveyed through the sewers into the river could in no case be heavier than the soil, but would generally be much lighter. While these substances might, to some extent, be deposited in the river when there was little or no current, they would, during seasons of rain and flood, be swept out by the same force that had hitherto preserved the depth of the river. "To many it is a matter of surprise," says Mr. Chesbrough, "that the river should maintain its depth, when there is so little current in it during most of the year; but those who have carefully studied this subject, see not only how the depth is preserved, but also how the spring and other freshets have been sufficient, from time to time, to make the upper parts of the South branch wider and deeper." While this was true enough Mr. Chesbrough did not, apparently, realize that the same spring freshets and occasional floods might sweep the accumulations of the sewers out into the lake to contaminate the water supply.

His objections to draining directly into the lake were : (1) The greater length of sewers required, and consequently greater cost ; (2) The difficulty in stormy weather of protecting the outlets from injury, or from being obstructed by sand and ice ; (3) The supposed effect on the water with which the citizens were supplied from the lake, if any of the

outlets should be near the pumping engine. From this it would appear that Mr. Chesbrough did not anticipate that the sewage discharged into the lake from the river could by any possibility ever reach the inlet of the water supply.

The objections to draining the sewage into reservoirs and then pumping it up to be used for agricultural purposes, were : (1) The great uncertainty about a demand for the sewage after it was pumped up, sufficient to pay for distributing it ; (2) The great evil that would necessarily result from a failure of the reservoirs through insufficiency of capacity, especially if the system of sewers leading to them should have their outlets too low to empty into the river or lake. If the reservoirs should be made so large as to place them beyond all doubt of sufficient capacity, they would be very expensive, both on account of labor and materials required in their construction, and the ground they would occupy ; (3) There would be danger to the health of the city during the prevalence of winds from the quarter in which the sewage might be distributed, especially if only a few miles distant, and spread over a wide surface.

“ With regard to the fourth plan, or draining into the proposed steamboat canal, which would divert a large and constantly flowing stream from Lake Michigan into the Illinois river,” said Mr. Chesbrough, “ it is too remote a contingency to be relied upon for present purposes ; besides, the cost of it, or any other similar channel in that direction, sufficient to drain off the sewage of the city, would be not only far more than the present sewerage law provides for, but more than would be necessary to construct the sewers for five times the present population. Should the proposed steamboat canal ever be made for commercial purposes the plan now recommended would be about as well adapted to such a state of things, as it is to the present, making it necessary to abandon only the proposed method of supplying the South branch with fresh water from the lake, and to

pump up from the new canal, or draw from the Desplaines directly flushing water from the West district, instead of obtaining it from the present canal at Bridgeport, as herein recommended."

To supply the mains with a constant current of fresh water, for the purpose of flushing them and the branches, it was proposed to lay lines of flushing pipes in Sixteenth, State and Washington streets, in the South division, Division street in the North division, and Ashland avenue in the West division. These pipes were to be four feet in diameter. In the South and North divisions they were to be filled by pumping from the lake, the water to be raised to a height of eight or ten feet, and in the West division by drawing directly from the canal at Bridgeport.

To keep the water in the South branch fresh, especially during the dry and warm seasons of the year, "when there would be danger of sickness from putrid exhalations," it was proposed to construct a canal twenty feet wide and six feet deep at low water, between the lake and the South branch through Sixteenth street. Its sides and bottom were to be protected with oak timbers and planks, and it was to be covered so that it might not interfere with the free use of the street. By means of an eighty horse power engine and a wheel, it was estimated there could be driven through this canal four hundred cubic feet of water per second, or 34,560,000 cubic feet every twenty-four hours, a quantity equal to all the water then in the river between the lake and Sixteenth street. Mr. Chesbrough's prophetic instinct failed him in his conclusion when he said: "With such a supply of fresh water from the lake it would be impossible for the South branch to become dangerous to the health of the city, even with all the sewage of its present and prospective population."

The sewers in the South division of the city had their principal dividing or summit lines on State and Washington

streets. Starting from these lines they discharged westwardly into the South branch between Sixteenth and Washington streets, northwardly from Washington street into the main branch of the river between Market street and the lake, and eastwardly into the large mains on Michigan avenue, one of which emptied into the river and the other into the lake at the foot of Twelfth street. Small branch sewers extended through the streets which were parallel with the summit lines, so that every lot might be reached. In the North division there were three main lines, extending from Division street to the main branch of the river, with outlets on Rush, Clark and Franklin streets. There was also a main having its outlet into the North branch at Chicago avenue. All the intermediate streets were drained by branches as in the South division. No sewer had its outlet into the lake from the North division. In the West division, mains were to extend from Ashland avenue to the South branch and the North branch of the river on the following streets: Division, Augusta, Chicago avenue, Indiana, Hubbard, Randolph, Monroe, Van Buren, Polk, Twelfth, Fourteenth and Sixteenth. For the immediate future it was planned to construct sewers only in Hubbard, Randolph, Monroe and Van Buren streets.

In December, 1856, Mr. Chesbrough was instructed by the sewerage commissioners to "proceed to Great Britain and the continent of Europe, for the purpose of examining the various methods of sewerage adopted there, and of taking such notes and drawings of the same as he may think necessary, and of examining into their operation, and into all matters connected with them, and which may, in his judgment, aid in the further prosecution and perfection of the sewerage of the city of Chicago."

Mr. Chesbrough complied with the order, and made a thorough investigation of the sewerage systems of Liverpool, Manchester, Rugby, London, Amsterdam, Hamburg,

Berlin, Paris, Worthington, Croydon, Leicester, Edinburgh and Glasgow. The results of his trip are given in a detailed report transmitted on March 25, 1858. No one of these great cities, he said, furnished an exact criterion by which to judge of the effect of discharging the sewage of Chicago into the river and its branches. Yet, their experience led him to fear that this city might yet conclude, as they had, that it would be necessary to keep the sewage out of the river. Chicago's plan was based upon the supposition, well founded, as has since been shown, that the natural state of the river during the summer months would require artificial aid to keep it in a healthy condition, and therefore provided for driving fresh water into the upper portion of the South branch from the lake. But the scheme for flushing the river was never carried out, and the idea was practically abandoned in 1860. The deep cut of the Illinois and Michigan canal had been proposed, and the commissioners concluded that the construction of the canal from the lake to the South branch along Sixteenth street, according to the original plan, would be unnecessary.

Mr. Chesbrough did not overlook the advantages of an outlet to the southwest. He said: "The through cut for a steamboat canal to the Illinois river, which the demands of commerce are calling more and more loudly for, if ever constructed, would give as perfect relief to Chicago as is proposed for London by the latest intercepting scheme; that is, it would furnish a constant and abundant stream from the lake flowing westwardly throughout the season of navigation, and consequently during the warm and sickly portions of the year."

In a memoir written by Mr. Benezette Williams, Mr. Chesbrough is credited with a remarkable foresight. Referring to the report which the latter made on his return from Europe, Mr. Williams says: "It is hard for us to appreciate the importance of this report and the effect it exerted not only

upon the destiny of Chicago, but also upon other cities of the country. It may aid us in doing so, however, to remember that at the time it was written there was not a town or city in the United States that had been sewered in any manner worthy of being called a system. The few detached, badly planned and badly built sewers that existed in some of the older cities had been constructed with little care as to the relation of one part to another, or to a connected whole. They had also been built with but small reference to grades, or proportions, or to the uses to which they were to be put. This being perhaps the first really thorough and exhaustive study which the subject had received at the hands of an American engineer, and Chicago being the only city on this continent to proceed systematically with a sewerage system, Chicago and Chicago's engineer soon became famous, and for twenty-five years thereafter E. S. Chesbrough was the recognized head of sanitary engineering in this country."

The construction of the city's sewerage system was continued substantially as planned by Mr. Chesbrough. The principal modification was the building of large trunk sewers on every second instead of every third street in the North and West divisions. Another modification consisted in omitting the arrangement for flushing the sewers. "In order to save as much of the expense of cleansing sewers by machinery as possible," said Mr. Chesbrough in his half-yearly report dated April 1, 1861, "a round tank, capable of holding about sixteen barrels of water, was obtained and mounted on a wagon drawn by two horses. It was found that by means of this the pipe sewers could, in most cases, be flushed clean from the manholes and at much less cost than the cleansing by machinery. This very satisfactory result has led to the construction of a much larger tank, rectangular in form, capable of holding about sixty barrels of water, and mounted on a very strong wagon, built especially for the purpose, and drawn by four horses, to be

used for flushing the smaller sized brick sewers as well as the pipes. This has now been in operation about two weeks, and proves very effective, as it can be emptied in about thirty-five seconds, and promises to diminish the cost of cleansing the sewers of a less diameter than three feet, one-half." This style of flushing tank has been in use ever since, the subject of many jocular remarks. With the aid of storm water it has kept the sewers partially clean.

Another, and the most serious departure from the plans of Mr. Chesbrough, was to discharge several trunk sewers directly into the lake both from the North and South divisions. This evil will not be corrected by the construction of the main drainage channel. Auxiliary works will be necessary.

The following table, which shows the distribution of population in the Sanitary District, and particularly the fact that the waste from a population of 270,000 discharges at once into the lake, was presented to the Trustees of the District in a report made by the joint Committee on Engineering and Finance on October 12, 1892:

" DISTRIBUTION OF POPULATION IN SANITARY DISTRICT.

	1886.	1892.
North Branch above Fullerton avenue	28,000	73,000
North Branch below Fullerton avenue	204,000	345,000
Total	232,000	418,000
Main River } North Side.....	62,000	86,000
and } South Side.....	72,000	90,000
South Branch } West Side.....	279,000	416,000
Total	413,000	592,000
South Fork	80,000	200,000
Total Tributary to River	725,000	1,210,000
Lake Shore.....	104,000	185,000
Total in District.....	829,000	1,395,000

"The destination of the sewage of the entire population of the Sanitary District and adjacent townships is shown in

the following exhibit for 1892, the figures being given in round numbers :

Chicago River.....	1,213,000
Lake Shore of Cook County (including the Calumet)	270,000
Desplaines Valley.....	22,000
Total	1,505,000

“Of this total, less than 1 per cent consists of rural population, and not over 2 per cent are outside of sewered districts. The essential fact is, that on a shore front of thirty-two miles, 270,000 of population drains to the lake at all times, and 1,493,000 whenever the river, from any cause, discharges lakeward; and further, that this population tributary to the river will reach a total of 2,000,000 before any radical change can be made.”

In his report of April, 1861, between four and five years after the sewers had been put into use, Mr. Chesbrough noted the favorable effects produced. They had made the streets in their vicinity much drier than previously. This was especially noticeable at the breaking up of winter, and after heavy rains. The subsoil had become drier near the sewers, and there was decidedly less dampness in cellars and basements. The owners and occupants of houses were particularly gratified. Mr. Chesbrough presented statistics showing a surprising decrease in the death rate of the city. Beginning with 1846, a rate of 23 per 1,000 increased to 53 in 1849. It was less than this for the next few years, but in 1854 it was 53.9. From that time there was a steady decline, until in 1860 it was only 18.8. The rate has not varied much since, being less than these figures as often as it has been greater.

The present city limits include an area of 181.75 square miles, or 116,320 acres. In this territory, according to the report of the Department of Public Works for the year 1891, about 2,335 miles of streets have been opened for public use, 775 miles of which have been improved by pav-

ing. In these streets, paved and unpaved, there were built to January 1, 1892, 4,690,338 feet, or 888,321 miles of sewers. Of these, 393,758 miles have been constructed of brick, and 494,563 miles of vitrified clay pipe. Their total cost was \$12,498,660.42. The largest sewers are nine feet in diameter, and of these there are 22,760 feet. There are 13,102 feet, 8 feet in diameter; 11,936 feet, $7\frac{1}{2}$ feet in diameter; 26,063 feet, 7 feet in diameter; 7,477 feet, $6\frac{1}{2}$ feet in diameter; 48,141 feet, 6 feet in diameter; 17,363 feet, $5\frac{1}{2}$ feet in diameter, and 116,740 feet, 5 feet in diameter. The smallest sewers are six inches in diameter.



CHAPTER VI.

EFFORTS TO PURIFY THE CHICAGO RIVER.

It was foreseen by Chief Engineer Chesbrough that the discharge of the sewers into the Chicago river would make that stream offensive. To remedy this, he proposed in his plan of 1855 to construct a covered canal in Sixteenth street through which water should be drawn from the lake by pumps to flush the South branch. The offense, so far as the sewers were concerned, does not seem to have become serious enough to attract official attention until the year 1860. In February of that year Mr. Chesbrough was instructed by the Sewerage Commissioners to visit the canal office at Lockport and learn what steps were to be taken by the Canal Commissioners toward deepening the canal.

"You are aware," said the Sewerage Commissioners, "that it has for a good while been regarded as desirable by many interested in the commercial prosperity of our state and the city, to make a channel by which the waters of Lake Michigan may flow directly to the Illinois river. To effect this, it is proposed either to cut down the summit of the Illinois and Michigan canal, or to make a new channel through Mud lake to the Desplaines river, and then to deepen the channel of that stream sufficiently to answer the purpose. The obvious bearing of this scheme upon the sanitary condition of the Chicago river, as affected by the sewage of the city, renders it desirable for this Board to obtain whatever reliable information can be had in reference to its practicability and expense, and the probability of its being carried out. As bearing also upon the same point, it is desirable to

obtain information as to the proposed pumping arrangements for the supply of the present summit level of the canal, as to what amount of water the canal company expects to pump from our river daily, and for what portion of the season of navigation."

Mr. Chesbrough's report was made in the following June. He thought the Board should not take any steps at that time toward the construction of a flushing inlet, or in doing any other work to introduce water from the lake into the South branch to purify the river. His reasons were: If the canal should be lowered at its summit level, such works would be useless; if the Calumet feeder should be cut off, as had been suggested, it would be necessary to create a constant stream up the South branch during most of the season of navigation by pumping if the canal should not be lowered; if the canal should not be lowered and the Calumet feeder should not be cut off, the experience of the preceding twelve years had shown that pumping was necessary about forty-six days in a year to keep the canal in navigable condition. He thought this amount of pumping would be sufficient to prevent any offensive smells that might have been caused from the sewage, "at least for some years to come." If the necessities of the Canal Trustees did not require them to keep their pumps at work long enough to meet the requirements of the city, it would be cheaper for the city to pay the Trustees to operate them about ninety days a year than to pay the interest on the cost of the Sixteenth street canal. This, in connection with what the canal trustees would find it necessary to do for their own benefit, would keep the pumps in operation about three-fourths of the time between May and November, "the only time," Mr. Chesbrough said, "during which any serious inconvenience could arise from the effect of sewage on the river. Sometimes in the coldest weather of winter," he added, "the water of the river, when covered with ice a foot or

more in thickness, becomes offensive to the smell ; at least, offensive gases are generated somewhere, and they make themselves very sensibly felt wherever they find openings in the ice. No detriment to the public health is found at such times, however."

Another important reason for deferring action on the flushing channel was that the board might profit by the experience of London which was then constructing works for the treatment of its sewage.

The history of the Illinois and Michigan canal will be found in succeeding chapters. It may be stated here that the construction of the canal was begun in 1836, and that it was completed on the "shallow-cut" plan in 1848. The contract for deepening the canal was let in 1865, but the work was not begun until two years later. It was finished in 1871. Not having been dug as planned at the outset, water would not flow through the canal by gravity across the summit. As a canal without water was useless it became necessary to erect pumps at the head of the canal at Bridgeport. The pumps were operated when the Des-plaines river ran dry, and drew water from the Chicago river.

In 1861 the Board of Sewerage Commissioners went out of existence. Their duties, together with those of the Water Commissioners and of other departments, were transferred to the Board of Public Works, which was organized on May 6, 1861. In his first report to the new Board, on February 24, 1862, Chief Engineer Chesbrough called attention to the impurity of the river. "There have been several occasions during the last three years," he said, "when many persons thought they could perceive the effect of the river in the taste of the water, but not until the night of the 10th inst., and during several days since, did that effect become so striking as to convince all who have examined into it of its real nature. On the morning of the 10th, the

wind being from the south and westward, the lake fell to an unusually low point. This, of course, caused a very large amount of water to be discharged from the river into the lake, producing the well known disagreeable effect upon its taste and smell, so that it could be distinctly perceived along the shore, from a considerable distance south of the river to the cemetery on the north. Since the 10th the water has twice been free from this taste and smell, and twice it has become offensive. The taste thus given to the water supplied to the city is much more offensive than that caused by the fish, while it is utterly impossible by any means at the disposal of the Board to prevent it at present."

Two questions presented themselves to Mr. Chesbrough's mind: What means had the board of preventing the contamination of the water supply in the early future, and how could the earliest possible relief be obtained? Before answering these questions he thought it best to point out the causes of the pollution of the river. While the sewers were responsible to some extent, the pollution was chargeable chiefly to the discharge of blood and other refuse from the slaughter and packing houses in and around the city, besides that from distilleries, glue factories, establishments for rendering offal, etc. To show that the packing houses and allied establishments were mainly responsible for the condition of the river, the chief engineer said: "Last spring the river became quite offensive in smell, and a committee was appointed by the City Council to confer with the officers of the canal in relation to changing the water in the river by pumping at Bridgeport. It so happened that before any arrangement was made it became necessary to pump to supply the wants of the canal itself, and nothing more was done by the city. During the whole summer and early part of autumn the river, though receiving its full amount of sewage, did not become so offensive at any time as to be a cause of complaint. Very soon, however,

after the packing season commenced, a most disagreeable odor was observed near the Old Street bridge on the South branch, which is above the outlet of any existing sewer. This peculiar odor could be traced afterwards, as it moved down stream, till it reached the mouth of the river."

Another proof that the sewers were not responsible for all the bad smells was that in 1860 the discharge from piggeries and cow stables high up on the North branch made that stream exceedingly offensive throughout its entire course. It was also very offensive during the preceding winter, yet, ordinarily, no sewer emptied into it, and two only, those on West Kinzie and Fulton streets, when there were heavy rains. Many of the older inhabitants of Chicago could remember that, before any sewers were built, and when the packing business was in its infancy, the river became so offensive from the discharge of blood and other refuse into it that a city ordinance was passed prohibiting such disposal of the waste.

Still another reason for the bad condition of the river was found in the prolonged and unusually cold winter. The river had been almost continually covered with ice, interfering with the purifying action of the air. "It has been like a bottle with two mouths," said Mr. Chesbrough, "which, originally filled with comparatively pure water, but receiving only continual accessions of filth into one mouth, soon ceases to discharge anything but filth from the other."

The chief engineer again referred to his suggestion that an arrangement be made with the Canal Board to keep its pumps in operation so much of the time during six months of the year as might be necessary to maintain a good condition in the river, and advised that the arrangement include occasional pumping in the winter. This was only a temporary expedient, pending the settlement of several important questions affecting the future of Chicago. "The questions alluded to are the probable growth of Chicago, the direction of

that growth, the harbor improvements that may be adopted, the construction of the proposed ship canal to the Illinois river, and the necessity or the expediency of imitating the great sewerage intercepting scheme of London now being carried out. The light which a few years will throw on these questions would be of immense advantage to Chicago in the planning of permanent works to remove the evils now complained of."

In the spring of 1862, Dr. Mariner, assayist of the city, was employed by the Board of Public Works to ascertain the causes of the black appearance of the river. He reported that the sewers, distilleries, slaughter houses, glue factories, etc., combined, were responsible, but that the gas works were more blamable than all the others. Dr. Mahl, chemist, was afterward employed by the City Council to make an investigation. He found that the greater portion of the river nuisance was generated along the North branch, into which not a single sewer ever emptied. All the sewers south of Madison street, with one exception, were of little importance. The excepted sewer was in Monroe street. This seemed to discharge about everything that could make the river foul. Mingled with its liquid contents were tarry substances "which," the chemist said, "have accumulated in the river to such an extent that its whole bed seems to be covered with it, for every steam tug wheeling up the water makes a portion of tar rise to the surface." These tarry substances could be traced from Adams street to Rush street. It is not necessary to say that the gas works were located on Monroe street. The slaughter and packing houses on the South branch could not then be charged with any of the offense, but the chemist had information to the effect that that they were leaving refuse matter where it would decay in the summer months. He thought it might as well be thrown into the river at the outset. He proposed that the proprietors of these establishments should convert their

waste matter into saltpeter, and the owners of the gas plant theirs into ammoniacal salts.

In his annual report dated April 1, 1863, Mr. Cheshbrough, now city engineer, again discussed plans for improving the river. These he divided into three classes: (1) Those which would drain the city into the Illinois river; (2) Those which would divert the Desplaines into the South branch of the river, and thus keep up a constant current to prevent offensiveness; (3) Making canals from the lake to the North and South branches and driving water enough through them from the lake to keep the river and the branches comparatively pure at all times. The first class, he said, was one requiring much larger means than the Board could then control. The second was defective since a supply of water from the Desplaines river would be likely to fail when most needed. The third was undoubtedly feasible, would be completely under the control of the city, and there was every reason to believe that it would be effectual.

In support of his claim that the third plan would be effectual, the city engineer noted the fact that after heavy rains, and while the canal pumps were not at work the South branch lost its "disagreeable color and smell." The City Council checked the nuisances on the North branch for a time, and the main river recovered a "very bearable condition which it retained until after the commencement of the packing season. Then the offensive smells reappeared in both branches and the main river and were perceived at the water works. As the amount of cattle and hogs to be killed here during the winter was known to be greater than ever before, it was with great reason feared that the condition of the river and of our drinking water would be more intolerable than ever. But soon after this threatening state of things commenced the season became unusually mild and rainy and has continued so ever since. Besides this, by an arrangement between the city government and the

Canal Trustees, the Calumet feeder has been discharged this way a good portion of the time. Owing to these causes, we have not had such exemption from offensiveness in the river and in drinking water for several years as we have had this winter. The above facts show that on the recurrence of another protracted rainless season we may look for a repetition of the evils already suffered, and that an effectual remedy therefor would be a constant current from the river into the lake."

It was proposed by Mr. Chesbrough to pump 400 cubic feet of water per second from the lake into the river through a covered canal or aqueduct, 12 feet in diameter. This amount would be sufficient, he said, to change all the water in the South branch and the main river in less than twenty-four hours. A head of one and a half feet at the lake would create the requisite current in the canal, and a steam engine of 100 horse power would secure this head. The water could be raised either by means of a bucket wheel, like those in use at Bridgeport to supply the canal, or by a propeller wheel such as were used on the lake boats. The probable cost of the canal and auxiliaries would be \$140,000. This estimate was sufficient to place the bottom of the canal sixteen feet below low water. It could then be used as a part of the main outlet of a system of intercepting sewers, if one should ever be adopted. The fact that they were carrying out such systems in London and Paris "admonishes us," said Mr. Chesbrough, "that sooner or later we may be satisfied that such a system should be carried out here. It is well to keep this subject continually in mind, and fortunately for us we have done nothing whatever to prevent the adoption of such a system whenever its necessity may become sufficiently apparent."

Still Mr. Chesbrough could not shake off the idea that an enlarged channel would yet be constructed to the Illinois river, although he did not expect the city to undertake the

work. If a flushing channel through Sixteenth street would be effective in purifying the South branch, why not construct one from the lake across the city to the vicinity of Bridgeport, since the river south of Sixteenth street would not be affected by the former, and another from the lake north of the city limits to the North branch? Estimating the cost, he concluded: "Should the national or state government ever construct the contemplated ship canal to the Illinois river, neither of the canals now mentioned would be needed for purifying the South branch, at least during the season of navigation and probably not in winter, except when repairs might be needed."

The Board of Public Works approved of the recommendations of the city engineer, and asked the City Council to pass an ordinance authorizing the Board to take immediate steps for the construction of the Sixteenth street canal and pumping works. The Council took no action on the recommendation and the Board of Public Works renewed it in 1864. But the Board had found that the canal would probably cost \$200,000 instead of \$140,000. In its report dated that year the Board said: "The condition of the river during the year has been about as it has been for the last two or three years. At times it has been in a very offensive state, nor can it be otherwise so long as it is made the receptacle of the filth of the distilleries, cattle and hog yards, slaughtering establishments and like establishments on its banks, throwing out an immense amount of animal and vegetable offal."

Commercial and sanitary interests joined hands in the winter of 1864-5 and agreed upon measures for the deepening of the Illinois and Michigan canal. The river does not seem to have become more offensive than it had been during the previous two or three years, but it was apparent that the ultimate result would be most serious unless steps were soon taken to purify it. Public discussions were had as to

the legislation which would best accomplish this object, and a joint committee was appointed by the City Council and Board of Trade to consider the matter. On the recommendation of this joint committee a commission was appointed by the City Council to continue the investigation. The commission consisted of Mayor F. C. Sherman, William Gooding, R. B. Mason, John Van Nortwick, E. B. Talcott and E. S. Chesbrough.

In the meantime the question was agitated in the State Legislature, and an amendment to the charter of the city was secured which authorized the appointment of two additional members on the Board of Public Works, empowered to act with the other members of the Board, but only on matters relating to the cleansing of the Chicago river. The new members were William Gooding and Roswell B. Mason. The regular members at this time were John G. Gindele, president, Frederick Letz and Orrin J. Rose. Before the special commission made its report, an Act was passed by the Legislature providing for the completion of the Illinois and Michigan canal upon the plan adopted by the state in 1836. This Act was approved February 16, 1865.

The preamble recited the fact that it had been represented that the city of Chicago, in order to purify or cleanse the Chicago river, by drawing a sufficient quantity of water from Lake Michigan directly through it and through the summit division of the Illinois and Michigan canal, would advance a sufficient amount of funds to accomplish this desirable object ; that the original plan of the canal was to cut down the summit so as to draw a supply of water for navigation directly from Lake Michigan, which plan was abandoned for the time after a large part of the work had been executed in consequence of the inability of the state to procure funds for its continuance, and that under the law the plan of the summit division was changed, the level be-

ing raised so as to require the principal supply of water through the Calumet feeder, subject to serious contingencies, and by pumping at Bridgeport. Then followed the enactment, which made these provisions:

1. To secure the completion of the summit division of the Illinois and Michigan canal, upon the original "deep cut" plan, with such modifications and change of line, if necessary, as will most effectually secure the thorough cleansing or purification of the Chicago river and facilitate the execution of the work, the city of Chicago, through its constituted authorities, may at once enter into an arrangement with the Board of Trustees of the canal with a view to the speedy accomplishment of the work.

2. The canal shall not be constructed of a less capacity than provided in the plan adopted by the Canal Commissioners in 1836, nor shall the work of deepening it be prosecuted so as materially to interfere with navigation. By consent of the Board of Trustees navigation may be opened later and closed earlier than usual in former years, but it shall never be diminished to a less time than six months.

3. It shall be lawful for the city of Chicago to enter upon and use any lands which may be necessary for right of way, if the route should vary from the present line of the canal, and to take and use any materials necessary for the prosecution of the work, their value to be determined in the manner provided by the general laws of the state.

4. The amount expended by the city of Chicago in deepening the canal according to the plan of 1836 shall be a vested lien upon the Illinois and Michigan canal and its revenues after the payment of the present canal debt, provided the cost shall not exceed \$2,500,000.

5. The state of Illinois may at any time relieve this lien upon the canal and revenue by refunding to the city of Chicago the amount expended in making the contemplated improvement and the interest thereon.

Under date of March 6, 1865, the city's Commission made its report to the Mayor and Common Council. This report gave in detail the plan for cleansing the Chicago river and was an important document. It is reproduced in full:

“The undersigned having been duly notified that they were, on the 9th of January, 1865, appointed a Board of Commission to devise the best plan for cleansing the Chicago river, and having carefully considered the questions involved in this important subject, have the honor to submit the following report:

“Knowing that various modes of purifying the river had been proposed by gentlemen of intelligence having a direct interest in the subject, we resolved to avail ourselves, as far as practicable, of their opinions. Accordingly, at our first meeting, we caused a notice to be published requesting all persons who had formed any plans for effecting the object in view to present them with the necessary explanations. In response to this request a great number of communications were received, some of them containing valuable suggestions and showing that much thought had been bestowed upon the important questions involved.

“We here desire to express our thanks to the parties who so kindly and promptly came forward to assist us in the solution of a difficult problem, and especially to those who had devoted much time to the preparation of elaborate plans and estimates.

“We do not deem it necessary to discuss, in this report, the merits of the various plans and suggestions which we have considered. Suffice it to say that at our different meetings we have endeavored to fully and impartially consider all their various merits and defects, and to give them all the weight to which, in our judgment, they were justly entitled.

“These communications more or less directly bear upon

three general plans which seem to be the only ones through which the main object in view can be accomplished, to-wit:

“1. Intercepting sewers which shall receive the filth that would otherwise flow into the river and carry it to the lake, to some point or points into which it would be pumped by machinery, thus keeping impurities out of the river to as great an extent as practicable.

“2. Cutting canals or making covered sewers from the two branches of the river to the lake, and by pumping works erected thereon force the filthy water out or the lake water in, thus keeping up a constant and sufficient current to keep the river pure. We do not believe that the necessary current can be produced by the natural action of the waves of the lake, as has been suggested.

“3. Cutting down the summit of the Illinois and Michigan canal below the level of the lake, so that a sufficient quantity of water may be drawn from it to create the necessary current through the main river and the South branch (and, perhaps, to some extent in the North branch also) to thoroughly purify the same at all times.

“Without recapitulating all the arguments which have been urged for and against these three general plans, it may be sufficient to briefly state a few of the prominent advantages and disadvantages of each.

“We believe the system of intercepting sewers has not been introduced anywhere in America as yet, and into but few cities in the Old World, where it has scarcely had a thorough trial yet, but is said to be steadily growing in favor. It seems to us that the system is more particularly adapted to older cities, where stringent municipal regulations can be more easily carried out, and where other facilities for getting rid of offensive matter are less available than here.

“It is believed that its advantages would consist in receiving and conducting, in covered sewers, to a point or

points outside of the city, the filthy contents of all the sewers that now discharge into the main river and branches, and thus prevent the water of the river, and from it the atmosphere of the city, from being polluted as at present. It would also allow the lowest districts of the city, which are now partially flooded in times of high water in the lake, to be drained better than can be done at present.

“Besides the first cost of construction, upwards of \$1,000,000, and the length of time, not less than two years, required to carry it out, the system of intercepting sewers would be subject to the disadvantages which necessarily belong to so complicated a scheme. At the outlet it would be necessary to construct, and keep in operation night and day, pumping works, to raise and discharge into the lake the constantly increasing filth of the city. Along the river and branches self-acting gates, or valves, would have to be constructed with great care in the first place, and forever after maintained with unceasing faithfulness.

“Should intercepting sewers be constructed for the purpose of receiving the discharges from distilleries, packing houses, and other establishments that have rendered the river offensive, it is to be feared that it would only remove the nuisance from the river to more vital points. The experience of the city thus far in the maintenance of its sewers shows that, while the men employed in cleaning have never been injuriously affected by ordinary house drainage, they cannot stand the emanations from substances improperly and unlawfully discharged into the sewers from packing houses or rendering establishments. It would be exceedingly difficult, if not impracticable, to prevent the effluvia caused by such establishments, as well as distilleries, from pervading all the sewers of the city, and causing serious complaints where no annoyances are now felt.

“Should it be found best ultimately to carry out a system of intercepting sewers in Chicago, and we are by no

means prepared to say it will not, we think there would finally be a necessity for keeping up a constant current in the river because it would be impossible to prevent the discharge of improper substances into it from the shipping, the docks, and sewers themselves, in times of heavy rain, to say nothing of what might be thrown into the North and South branches outside of the limits and jurisdiction of the city, and afterwards brought within by a sluggish current.

"In regard to the second general plan, we think that there can be no doubt that it can be made to accomplish the main object desired at a less expense at the outset than any other. To do this in the most effectual way, we would adopt the following specific plan, to-wit:

"An open canal from the South branch to the lake through or near Douglas avenue; length 13,700 feet, width at bottom 25 feet; at surface at low water of Lake Michigan 65 feet, and depth 10 feet. Estimated cost, \$547,230.

"Also an open canal, of the same dimensions as above, from the North branch of the Chicago river to the lake, through or near Fullerton avenue. Length 11,200 feet, and estimated cost, \$469,269.

"These canals would have a capacity sufficient to discharge 24,000 cubic feet of water per minute each (without raising it more than four inches), which, it is supposed, would change the entire volume of water in the river once in forty-eight hours. The machinery for pumping might be placed either upon the river or lake ends of the canals.

"The advantages of this plan consist mainly in its simplicity, the comparative cheapness of construction, and the facility with which repairs could at any time be made.

"Its disadvantages would be found in the constant expense of sustaining and operating the machinery, keeping the canals in repair, protecting and keeping open their entrances into the lake, and contingencies to which works of this kind are more or less liable. These can, however, be

provided against, in a degree, by duplicating the machinery. Another objection to both this and the intercepting sewer plan is, that all the accumulated filth of the city must be discharged within or near its limits.

“The estimated cost of the third plan for purifying Chicago river, which is to cut down the summit of the canal below the level of the lake, so as to draw from it, at a low stage, not less than 24,000 cubic feet of water per minute, is \$2,102,467.50.

“This estimate provides for increasing the capacity of the canal somewhat over the plan adopted by the Canal Commissioners in 1836, so as to create a current in Chicago river which is deemed sufficient to cleanse it. The quantity of water drawn from the lake through the river would seldom be less than 24,000 cubic feet per minute,* and at the average stage of water much greater.

“The advantages of this plan are briefly as follows :

“1. It furnishes the only possible self-acting means of cleansing the main river and the South branch (and possibly to a certain extent the North branch also) every hour of the day, and every day of the year, for all time to come.

“2. The filth of the city which passes into the river will be drained off into the canal without contaminating the waters of the lake, and the continual current will prevent the water in the river from ever becoming very offensive.

“3. The cost of construction will be the only expense to the city, as all subsequent expenses in keeping the channel open, and enlarging and improving it, will be borne by the state.

“4. The money expended in cutting down the summit of the canal, so as to procure the supply of water directly from Lake Michigan, will constitute a part of the expense of enlarging the present canal so as to admit the passage of steamboats of the largest class,—an improvement which must soon be made.

"5. By using the present summit locks, or, if the canal be enlarged, constructing other locks at each end of the 'deep cut' of the enlarged dimensions, a large quantity of water could be accumulated at any time by filling the canal to the present surface, which could be suddenly discharged into Chicago river, making a strong current to the lake. This may never be necessary, but the plan admits of the arrangement described, should it hereafter be deemed desirable.

"We have mentioned the prominent advantages of the plan. The principal disadvantages are its cost and the time which must be occupied in doing the work. The probable cost has been given. The time which would be required to execute the work economically, without seriously interfering with the navigation of the present canal, would be about three years.

"But no other plan by which the river could be effectually purified could be executed in less than one year; so for a year, at least, some means within reach must be adopted to remedy the evils which it is intended ultimately to entirely obviate.

"It is believed that the hydraulic works at Bridgeport, if worked to their full capacity, or even so as to raise all the water which the present canal, with some slight additions to its banks, could discharge, would prevent the river from becoming very offensive, if especial vigilance were exercised to keep out deleterious substances. This we deem of the utmost importance, and, in fact, indispensable to the well-being of the city, until some plan of thorough drainage be carried out.

"Even then, it appears to us, that the distilleries which have at times rendered the waters of the North branch almost putrid, and other establishments which have given Chicago a world-wide fame for its vile odors, should not be permitted to remain the nuisances which they have been.

Certainly the process of thoroughly cleansing the river would be greatly simplified if no more offensive substances were discharged into it than could possibly be avoided. It would seem to be the part of wisdom as much to avoid an evil, if possible, as to cure it.

“Until some plan for cleansing the river be fully completed, it should not be expected that the temporary remedies which may be resorted to will entirely prevent the water from becoming impure. They will only mitigate the evil.

“The recommendation has frequently been made that the Desplaines river should be turned into either the South or North branch, and thus purify it; but at the very season when the process would be most needed, there is not water enough in that river to do any good, and if there was the city has no right to take it. But it is said that the river would furnish, in times of freshet, water enough to scour the South branch and main river two or three time a year so thoroughly that it could not become very offensive in the meanwhile, and would also be kept in a far better navigable condition. As a measure of satisfactory relief from nuisances in the river, we believe it would not answer the purpose. As an important aid in maintaining a suitable depth in the harbor, we think it might be made valuable; but after careful examinations and surveys we are thoroughly satisfied that the small expenditures heretofore recommended for the purpose would be totally inadequate. Some of us have had actual experience in matters of this kind, and we believe that a canal that would cost less than \$100,000 would only end in disappointment. To this sum should be added whatever it might cost to dredge out deposits in the river below Bridgeport, brought in from the canal.

“The Commission has made the proposed survey of Desplaines river with reference to a new channel from Bridgeport to Lockport, independent of the Illinois and Michigan canal, which was referred to us by your honorable

body. We have found, as was expected, very extensive deep places in the channel of the river, but notwithstanding this, it would cost upward of \$1,000,000 more to make a new channel of equal size to that of the Illinois and Michigan canal, from Bridgeport to the Desplaines river, and thence down that stream to Lockport, than it would to deepen the present canal. The new channel, after being completed, would be encumbered with the drainage of the Desplaines valley; but the present canal deepened would not.

“In case it should be thought advisable to construct the proposed canals between the lake and the North and South branches, the question of power to be used becomes an important one. We do not, at present, feel perfect confidence in anything but steam; but the experience of several of the railroad companies of this state in the use of windmills is so satisfactory, and withal so economical in first cost and maintenance, that it might be worthy of a trial, and we think it far more promising than reliance upon the action of waves, because these could only be depended upon during northerly or easterly winds, while windmills could take advantage of any breeze. There is also another natural power that could be made use of, and that is a species of tide or ebb and flow occurring sometimes as often as once in ten minutes in the calmest days of summer. The cause of this ebb and flow has never been satisfactorily explained, to our knowledge, but of its existence there is no doubt, and as little that by means of self-acting gates it could be utilized for changing the water in the proposed canals, to some extent at least, if not to a sufficient one for permanent benefit.

“The suggestion has been made that reservoirs could be constructed on the North branch of the Desplaines, and a sufficient quantity of water stored in them to flush the river occasionally. This could undoubtedly be done, but a slight investigation of the subject will show the impossibility of obtaining from such sources a supply sufficient to keep the

river pure at all times, unless at a cost greatly exceeding other methods ; and as the value of but two or three flushings during the season is so doubtful, when compared with a constant purification, we do not think it advisable to construct such reservoirs.

“In view of all the facts of the case, the best plan for cleansing the Chicago river that we can devise, is to cut down the summit of the canal so as to draw a sufficient quantity through it from the lake to create the necessary current in said river.

“We are aware that the first cost of executing this work would exceed that of constructing short canals from the North and South branches to the lake and erecting the necessary machinery thereon. We are aware also that, theoretically, the interest on the additional cost would be more than the expense of operating said machinery. But we do not think that in deciding this question we have a right to disregard other considerations of great importance to the interests of the city, especially the law passed at the recent session of our State Legislature which gives the city of Chicago a lien upon the Illinois and Michigan canal and its revenues after the payment of the present canal debt, until the whole cost of making the ‘deep cut’ and the interest accruing thereon shall have been reimbursed to the city.

“With regard to the North branch, while we consider the proposed open canal from the lake to the river, along or near Fullerton avenue, the best plan to recommend for permanently cleansing it, if the discharge of filth into it must be suffered to go on as heretofore, we believe it is both the right and the duty of the city to prevent all such discharges. This would be by far the simplest, cheapest, and quickest way of purifying that branch ; in fact, the only method we can think of to obtain immediate as well as permanent relief.

“It has often been said within the last three years, that

any effectual prohibitions of such discharges would drive the distilleries from the city and thus inflict a serious blow upon its prosperity. By an Act of Congress, of last year, such heavy taxes were imposed upon distilled liquors as to cause the stoppage of these distilleries last July. But one has resumed work since, and that within the last two months. As a result the north and northwestern portions of the city have enjoyed unusual freedom from nuisances, which were often before of a most abominable character, while no complaints of any injury to the general growth or prosperity of the city have been heard of.

"The proposed canal on or near Fullerton avenue would cost, as already stated, about \$500,000, and probably cost not less than \$20,000 annually afterward to maintain it, particularly if steam power should be required. It would be better for the city to pay now at least \$500,000 should that be necessary to prevent the North branch from being polluted, than to construct and maintain this canal, whatever may be the final necessity for keeping up an artificial current in said branch. We believe the true policy of the city is to prevent all nuisances, as far as possible, from being made, and then the unavoidable ones will be comparatively easy to remedy. The proposed canal would probably encourage and increase, to a very great extent, filthy discharges into it and the river from establishments that would be, most probably, nuisances of themselves to their neighborhoods.

"The present sewerage system of the city has been planned and thus far carried out at some additional inconvenience and considerable expense, with reference to keeping the North branch as free as possible from pollution, for the purpose of avoiding the heavy expense that would otherwise be required to purify it. Up to this time there is but one sewer, and that only a few blocks long, on Chicago avenue, that discharges constantly into the North branch.

The West Kinzie street sewer discharges into it during heavy rains only. The probability is that, for many years to come, the amount of sewage it may be necessary to discharge into that branch would not be sufficient to cause offensiveness, if the establishments above mentioned, as well as similar ones, can be prevented from discharging their filth into it."

The plan proposed in the report of the commissioners was promptly approved by the Common Council. The Board of Public Works caused the necessary surveys to be made, and prepared to enter upon the work as soon as possible. A formal request was addressed to the Board of Trustees of the Illinois and Michigan canal asking that authority might be granted to the city to deepen the canal in the manner proposed, and that the water might be let off from the canal from November 15 to April 15, of each year during the progress of the work. The Canal Trustees granted the request under certain conditions. The time for opening the canal in the spring was fixed at April 1, instead of April 15.

Bids for the enlargement of the canal were received on September 2, 1865, and after some delay contracts were executed with Fox, Howard & Walker for the work on sections 1 to 44, at 33 cents per cubic yard for the earth work, and \$2 for the rock excavation, and with Sanger, Steele & Co., for the work on sections 45 to 64, inclusive, rock exclusively, at \$1.64 $\frac{3}{4}$ per cubic yard. These two contracts covered the entire work. The time stipulated by Sanger, Steele & Co., for the completion of their contract was April 1, 1868, and by Fox, Howard & Walker, September 1, 1868. Little was done during the first winter, as the time was short for procuring and setting up machinery and for building the necessary dams and protecting works. In order to hasten the work during the following winter, an arrangement was made with the Canal Trustees to close the

canal one month earlier than the stipulated time, or on October 15, the city to pay for lost tolls during the month \$20,826.13, and the Canal Trustees added another set of boilers to their pumping works. This kept the river clean up to the time work on the canal began. The pumps were set in motion the latter part of June and were operated steadily, the result being that the river, with the exception of the North branch, was free from offensive odors. The city agreed to pay the Canal Trustees the expense caused by the extra pumping. The offensiveness of the North branch was still charged to the distilleries, and the city seemed to be unable to enforce its ordinances prohibiting the use of the river as the receptacle for their waste.

To raise the money necessary to pay for the enlargement of the canal, bonds were issued, known as river improvement bonds. These bore interest at the rate of 7 per cent, and the face value of each was \$1,000. Ninety-three of these bonds were sold the first year. Although bearing so high a rate of interest they were discounted nearly 9 per cent, the proceeds of the first lot amounting to \$84,669.11.

The prices at which the work was let did not seem to be remunerative to the contractors, and the progress made was very unsatisfactory to the city. The contracts were therefore annulled and no work was being done at the close of the working season in the spring of 1867. The Board of Public Works advertised for new proposals to be submitted on May 1, 1867, but the Board authorized Fox, Howard & Walker to keep their dredges at work, payment to be made at the new rate. To maintain the sanitary condition of the river, the Bridgeport pumps were operated only from June 21 to September 5, but the city paid the Canal Trustees for lost tolls from November 1 to November 15, 1866, \$8,642.99, an item which measures the anxiety of the city to hasten the work. The amounts for increased pumping

and lost tolls became greater from year to year as the work progressed.

When the new proposals came in on May 1, 1867, they were so high that the Board of Public Works would not take the responsibility of letting contracts under them, and the whole matter was referred to the Common Council. By direction of the Council contracts were closed for a portion of the work at once, and for the remainder, the following spring. There were now twelve contractors instead of two, and the time for the completion of the work was extended to March 31, 1871. At the request of the Board of Public Works, the Calumet feeder was discharged through the canal into the river during the winter of 1866-7. The outward current prevented the accumulation of filth in the river, and left it in good condition in the spring.

Less than 5 per cent of the sewage of the city was discharged into the North branch at this time, and for some years afterward, but the refuse from the distilleries had made it so offensive that attention was directed specifically in the spring of 1870 to means for its purification. City Engineer Chesbrough suggested several plans, one of which he recommended for adoption. This provided for the construction of a conduit in Fullerton avenue. The recommendation was concurred in by the Board of Public Works, but no immediate action was taken by the Common Council. The plan was afterward carried out.

Of numerous plans which had been proposed for cleansing the North branch, Mr. Chesbrough mentioned four: (1) intercepting sewers; (2) canals between the river and the lake; (3) reservoir high up the river; and (4) artesian wells. By the use of intercepting sewers, there would be no drainage into the river. Such sewers, he said, should be made near to and parallel with the river. They would necessarily be lower than the lake and incline toward their outlet, requiring their contents to be pumped up. Here arose

an important question, as to whether there should be but one outlet for the entire city, and where that should be. This question suggested three others: (1) What was to be the final use or disposal of the sewage of the city? (2) What the probable cost of any plan of intercepting sewers? (3) What the cost of maintainance?

The experiments in Europe during the previous twenty years in methods of sewage disposal had been watched in Chicago with a great deal of interest. "The result thus far seems to be," said Mr. Chesbrough, "that no city containing a population of 100,000 or upwards, has been able to utilize the contents of all its sewers in the irrigation of land; and yet, of all the methods hitherto tried, this has by far the greatest number of able advocates, both in England and France. The attempt to manufacture sewage into solid manure has proved a commercial failure. The process of deodorization by means of lime or chemicals is enormously expensive, and has not proved satisfactory in its results. As yet, there seems to be no alternative for large cities but to discharge the contents of their sewers into some running or large body of water, and at the nearest point compatible with public health. What the future may develop, it is difficult now to foresee, but in the light of experience thus far gained, the strong probability is that the ultimate receptacle of the sewage of this city must be the lake, either from the river, or from the outlets of intercepting sewers. In the latter case the contents of the intercepting sewers would descend towards the lake and there be pumped up. If, however, irrigation of the land should ever prove advantageous here, then the intercepting sewers should incline towards the districts to be fertilized and their contents there pumped up."

While the cost of a complete system of intercepting sewers for the entire city would depend upon the district and the population, Mr. Chesbrough thought it would not

be less than \$3,000,000. Investigation as to what the city had the power and the resources at that time to do, led him to recommend a covered canal, or conduit, circular in form and 12 feet in diameter, along the line of Fullerton avenue, with the requisite machinery for pumping or driving water in either direction, near the North branch. Such a canal would be two miles long. With a bottom 14 feet below low water, and a head of $4\frac{1}{2}$ feet, it could be made to discharge 24,000 cubic feet of water per minute, sufficient to change all the water in the North branch and main river every thirty-six hours. The estimated cost of the canal was \$480,000, including the cost of machinery. The machinery recommended was a 300 horse power engine and a propeller wheel so placed as to draw or drive the water in the direct line of the canal.

A navigable channel had been proposed, with sufficient size to pass the largest vessels navigating the lakes, thus creating four miles of additional dock front, making it less expensive to force the necessary quantity of water into or out of the river. Both the authority and the propriety of the city's undertaking such a work were considered doubtful.

"This is perhaps the most proper place to mention," said the chief engineer, "that some of our ablest citizens have started the project of a ship canal between the North branch and the lake, $2\frac{1}{2}$ miles north of the city limits, where the ground is very favorable for such a purpose and the land much cheaper. Should this work ever be carried out, and the North branch be made navigable to it, the owners of such a canal could easily supply the current desired, and a much greater one than it would be practicable to supply through the covered canal.

"To avoid the expense of steam machinery for producing the requisite current in the covered canal, it has been proposed to construct a long basin, with sloping sides, on

the lake shore, and let the wind and waves drive water enough into it to supply the canal. Besides the various doubts with regard to the working of such an arrangement, the necessity of always relying upon a current from the lake into the river would be very objectionable. It is expected that by next spring the South branch will be drained into the Illinois river, through the deepened canal, but it was never supposed that this would purify the North branch. If the North branch must discharge its filth, in all stages of the stream and at all seasons of the year into the main river, then the water to flow from the main river into the South branch, instead of being drawn from the lake, would be the foul discharge of the North branch. It is easy to see that in that case there would be great disappointment with regard to the expected benefit of deepening the canal. It would therefore be necessary, in constructing a canal between the North branch and the lake, for the purpose of purifying the former, to provide for discharging into the lake whenever there might be very little or no natural current in the river.

“A reservoir high up the stream, sufficient to supply for one month the quantity it is proposed to drive through the covered canal, would, it is estimated, cover about 2,500 acres. When it is considered that not merely one month's supply, but four, and possibly six or even more, might be needed, it seems useless to discuss such a plan. But if the great cost of this plan did not stand in the way, the impossibility of producing any current, except towards the mouth of the river, would be a great objection. Besides the necessary exposure of such large surfaces as a reservoir would cover, by the drawing down of the water in warm weather, could not be tolerated.

“Supposing it practicable to get water enough from artesian wells to produce the requisite current, leaving out of view the objection that it would be impossible to turn that

current from its natural course into the main river, the number of such wells, judging from the most successful one yet bored in this city, that of the Union Stockyards Company, would have to be 405, that is if 24,000 cubic feet per minute should be required. All experience thus far, in other cities and countries where many artesian wells have been bored, goes to show that their enlargement, either in size or number, does not produce a corresponding increase in the quantity of water furnished. There is no good reason why a different result should be expected here, but strong proof to the contrary."

In the light of his knowledge Mr. Chesbrough did not think it advisable to begin the construction of a system of intercepting sewers, although the probability of having to do so ultimately seemed to increase from year to year. He urged again the construction of the proposed covered canal on Fullerton avenue. In answer to the objection that the outfall of the sewage at the lake end of the conduit would create a nuisance on the Lake Shore drive, he said if enough lake water were introduced into the North branch to render it inoffensive and then discharged through the proposed canal into the lake the nuisance would not be diminished. "Let what may be done," he concluded, "such a city as this cannot get rid of all its filth without producing something unpleasant to sight or smell somewhere, and no more convenient or economical receptacle for the whole of it can be suggested at the present time than the lake, if the objectionable condition of the North branch is to be remedied."

By cutting away a temporary dam which had been thrown across the canal at Bridgeport to stop the flow of water from the river the final act in deepening the Illinois and Michigan canal was accomplished. This occurred on the afternoon of Saturday, July 15, 1871. "Quite a strong current was at once created, and an entire change of the

water in the main river and the South branch was effected in about thirty-six hours." The water in the South branch is said to have become "quite clear and entirely free from noxious odors," and the favorable effect upon the water of the North branch was perceptible.

The completion of this work was an impressive event in the history of the city. "No more important and necessary public improvement has ever been undertaken by the city," said the Board of Public Works. "The water of the river has become more and more filthy and offensive with the increase of our sewers having their outlet therein, and the absolute necessity of providing a way of carrying off this accumulation of filth has become more and more apparent. It is confidently believed that this will prove an adequate and permanent means of relief so far as the main river and the South branch are concerned."

The total amount expended by the city in deepening the canal was \$3,300,883.71. The discount on the canal bonds amounted to \$95,682.61, and the total of lost tolls paid by the city was \$43,501.07. By the Act of the Legislature authorizing the work the city was given a lien upon the revenues of the canal to the extent of \$2,500,000 and interest. As a compensation for the loss by the great fire of 1871 the Legislature, on October 20 of that year, appropriated \$2,955,340, with interest until paid, to relieve this lien. There was this provision in the Act that not less than one-fifth, nor more than one-third, of this sum should be applied by the city in reconstructing the bridges and public buildings and structures destroyed by the fire, the remainder to be applied to the payment of the interest on the bonded debt of the city and the maintenance of the fire and police departments.

For some years the effect upon the South branch was wholly satisfactory. "At all ordinary times now," said the chief engineer in 1872, "the water of Lake Michigan

enters the mouth of the river, flows up it and the South branch to feed the canal, thus completely deodorizing what was so offensive and unbearable a year ago." "But observation as well as reflection shows," he said a year later, "that the purifying power of the canal is limited, and it will not do to suppose that any amount of filth, from a city of the size to which Chicago promises to grow, may be discharged into the river and branches for all time to come without producing injurious results."

The condition of the North branch had become worse than ever. In the fall of 1872 Alderman Schaffner proposed in the Common Council that it be cleansed by means of artesian wells, the water from them to be first discharged into the sewers. A report was made to the Council on September 5, which seems to have settled this question. It was shown that it would require more than five hundred wells to discharge 24,000 cubic feet of water, or 180,000 gallons per minute, the amount it had been assumed would be necessary to purify the North branch. These at an average cost of \$5,000 represented an investment of \$2,500,000, or five times the estimated cost of purifying that part of the river in what was believed to be a more certain way, by means of a canal or conduit from the lake. It was also urged that the filthy water of the North branch would be carried, by the introduction of more water up stream, to the forks of the river, where, at ordinary times, it would enter and flow up the South branch, adding one-fourth to the foulness of the latter. Again, there was doubt that the expected supply of water could be had from artesian wells; if it could, a steady discharge of water into the sewers would not remove the deposits in them, this requiring a sudden dash of a large quantity of water.

Of the river in early days it is to be said that it was a clear stream and a choice fishing ground. "Citizens of Chicago who lived here upwards of twenty years ago,"

says the 1872 report of the Board of Public Works to the Common Council, "remember well that the North branch, previous to the erection of any distilleries on it, was a clear stream with a gravelly bottom, and abounded in fish."

Charles Cleaver, who came to Chicago in October, 1833, in some early reminiscences published in Fergus' Historical Series, gives an interesting account of a fishing excursion on the North branch soon after he arrived. There was no difficulty in seeing fish at the bottom of the river, he said, even in six feet of water. "In those times," he added, "it was a clear, sparkling stream with quite a strong current, especially near the dam, five miles from the city, over which the water rippled and ran, making a soft, soothing, murmuring sound heard on that still winter's night for a considerable distance before we reached it."

CHAPTER VII.

OUTLET TO THE MISSISSIPPI.

By constructing an artificial waterway from Lake Michigan to Joliet, Chicago will restore an ancient outlet to the Mississippi. The great lakes were once an arm of the sea, like the Baltic in Europe. An upheaval of the earth left this body of water in a depression of its own. The tides of the ocean no longer swept through it, but its own overflow sought the sea in mighty rivers. Its surface was many feet, perhaps hundreds, higher than it is now. There is abundant evidence of this. Deposits of sand and clay containing fresh water shells on the shores of Lake Huron are found forty feet above the present water level, and extend back in some places twenty miles. Terraced deposits of alluvial material, indicating former water levels, extend along the shores at heights ranging from 120 to 200 feet. Seven ancient beaches were found by Logan at intervals up to a height of 331 feet above the level of Lake Superior.

With such a volume of water in a great reservoir at the summit of the continental watershed, continually increased by melting glaciers and almost constant precipitation, the outfall both to the east and the west was enormous. With the passing of the glacial epoch the ice withdrew to the north, the waters settled in their individual basins, the bed of the channel to the eastward yielded to their corroding action and there has since been a continuous discharge through the St. Lawrence to the Atlantic. The rocky ridge west of Lake Michigan, like an imperfect dam, weakened at

one point and a crevasse was opened through the solid limestone to a depth of 200 feet. For ages the waters of the lake were poured into the Gulf of Mexico, through this outlet, by way of the Mississippi valley. The trough hewn out of the rock for a distance of twenty miles, the bottom of which is only six feet above the present level of the lake, is from one to two miles in width. It may be said to begin at Summit, eleven miles west of Lake Michigan, and to end at Lockport, twenty miles further west and south. It is in the bed of this natural outlet that a new channel is now being excavated, of sufficient depth to renew the outflow from the lake.

In Worthen's "Geological Survey of Illinois," H. M. Bannister says it is evident, with very little observation, that at a comparatively recent period, subsequent to the glacial epoch, a considerable portion of Cook county was under the waters of Lake Michigan, which at that time found an outlet into the Mississippi valley through the present channel of the Desplaines. The deposits of this period consist of beds of stratified sand and gravel in the central and eastern portions of the county, either underlying the flat prairies or arranged in the form of ridges, skirting the shores of the lake, and in one or two cases trending westward away from it to a distance of several miles. These ridges, he says, seem to indicate the shores of the ancient bay, which with these boundaries would require the level of Lake Michigan to be nearly forty feet higher than at the present time. The outlet was evidently near Summit, where an alteration of the level for a very few feet would send the waters of the Chicago river into the Desplaines.

Another very evident outlet, to the south of this, was through the channel utilized by the Calumet feeder, joining the Desplaines at the Sag. The mound or ridge at Blue Island, Mr. Bannister thinks, must be referred to this level of the waters. He found numerous evidences of a power-

ful stream on the rocks at Athens, in the shape of water-worn surfaces, pot-holes, etc. The nearest ridges running parallel to the present coast line, appear to him to indicate a very gradual recession of the waters of the lake, before reaching its present limits. The structure of these ridges, he finds, is similar to that of beach deposits, generally consisting of irregularly stratified sand and gravel beds, with sometimes a thin seam of vegetable mold. This structure, he adds, is well displayed on the lake shore north of the University grove at Evanston, where the wearing action of the lake storms upon the shore has cut down one of the ridges upon which the town is built.

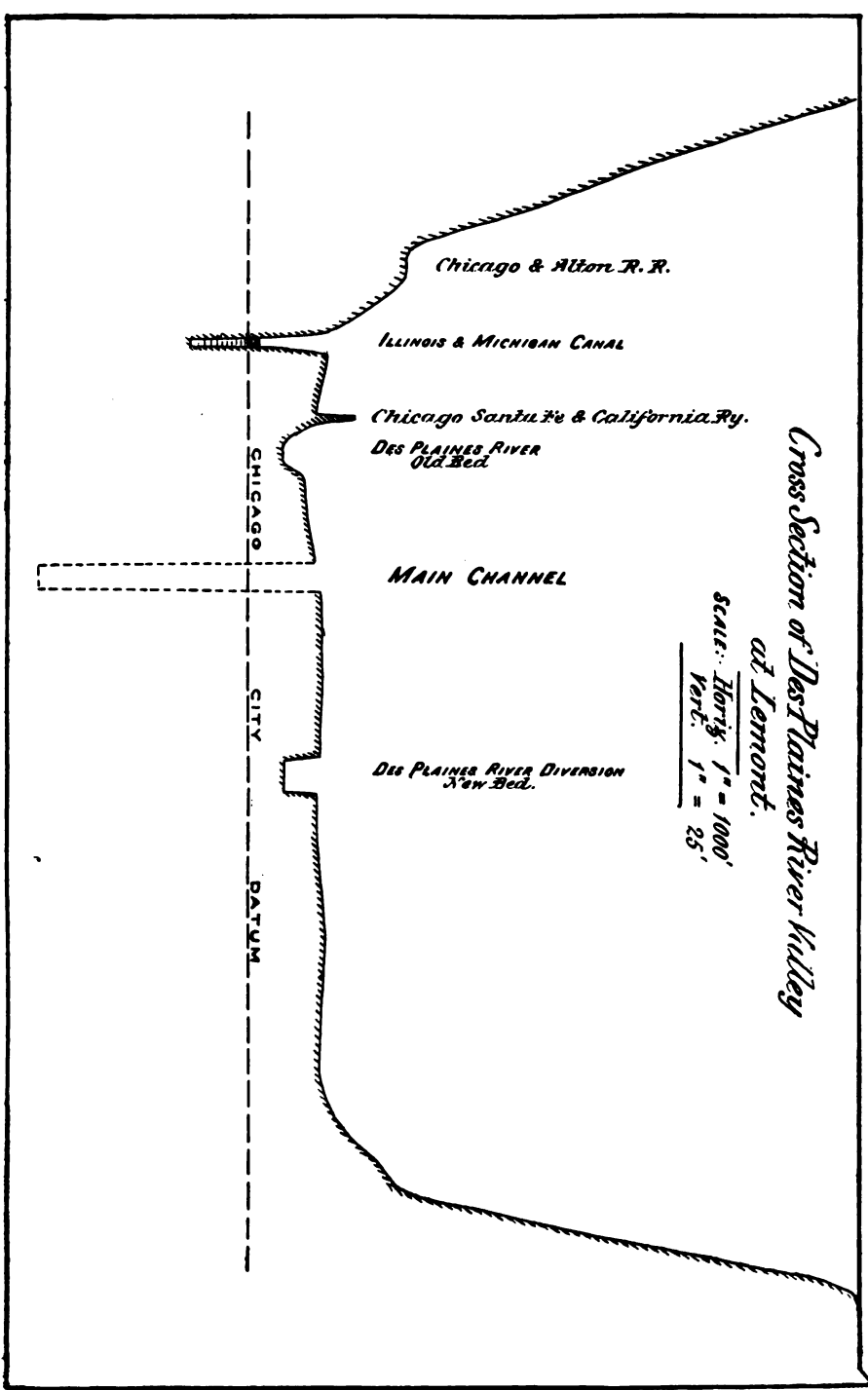
Frank H. Bradley, who wrote the geological history of Will county for the same work, says that throughout the valley of the Desplaines, DuPage and Kankakee rivers the alluvial deposits constantly remind the observer that Will county once bordered the lower end and the outlet of Lake Michigan. The mounds along the Desplaines which were formerly attributed to the industry of the aboriginal mound builders, are, to him, evidently the islands and banks of the old western outlet.

There are varying opinions as to the manner in which this outlet was created. Worthen says of all the river valleys of the state, that if we could strip off from the surface the superficial deposits of sand, clay and gravel, varying in depth from ten to one hundred feet, we should find broad and deep valleys, cut into the solid rock strata to a depth varying from one hundred to three hundred feet. It is his opinion that these valleys were excavated, in part, at least, by streams of water, but that they may have been greatly enlarged by the joint action of ice and currents of water, perhaps during a period of submergence, and were afterward filled, either wholly or in part, by the superficial material called drift which now occupies them.

Ossian Guthrie, whose name has been associated with

Cross Section of Des Plaines River Valley at Lemont.

Scale: Horiz. 1" = 1000'
Vert. 1" = 25'



CROSS SECTION OF ANCIENT OUTLET AND DRAINAGE CHANNEL AND WATERWAY.

every effort of the past forty years to renew an outlet to the Mississippi, and who has made personal investigations of the physical conditions, believes that the Desplaines valley was excavated by glacial action. In a paper read before the Geological Society of Chicago he estimates that the glacier, which, he believes, once occupied the bed of Lake Michigan, was 2,500 feet in height above the present surface of the lake at its southern extremity, and 16,000 feet in height at its source. He traces the course of this glacier by its moraines, and concludes that it turned to the westward at the present location of Chicago and ploughed its way through the rocky divide. There were two channels, one by the way of Mud lake and the other by the way of the Sag. "Hundreds of acres of rock, easy of access and in many places exposed to view," he says, "are glacial scored and plainly indicate this; and along both channels glacial debris is scattered in such variety and profusion that it would seem to be more difficult for the geologist to lose the glacial trail than to follow it."

A remnant of the ancient stream is found in the Desplaines river, which now, a mere thread, winds through the valley over its rocky bed. This river rises in the southern part of the state of Wisconsin, and flows southward parallel with the western shore of Lake Michigan, twelve to forty miles distant. At Summit it turns abruptly to the southwestward and follows the valley to a point sixty miles below Chicago where it unites with the Kankakee to form the Illinois. The Illinois river continues southwestward across the state emptying into the Mississippi at Grafton, 325 miles from Chicago. From Chicago to Romeo, a distance of twenty-seven miles, the bed of the Desplaines river is six feet above the level of Lake Michigan. From Romeo to Joliet a distance of ten miles, there is a descent of seventy-seven feet, the greater part of it below Lockport. From Joliet to Lasalle, a distance of sixty miles, there is a further

descent of seventy feet. From Lasalle to the mouth of the Illinois, 225 miles, the fall is only twenty-seven feet.

It is more than two hundred years since the Desplaines valley was discovered, but it became at once the path of communication between the previously settled portions of Canada and the valley of the Mississippi. History gives the credit of the discovery to Joliet and Marquette, but it is certain that French traders penetrated this region many years earlier. The latter faced the perils of exploration solely for purposes of gain, and have left no records of their discoveries and their transactions with the Indians. Organized exploration in the western parts of America was prompted by a desire to discover a waterway across the continent.

Apsley, a London dealer in beads, playing-cards and gewgaws, in the days of Queen Elizabeth, said he expected to live long enough to see a letter carried to China by a water route that would be discovered across the American continent between the 43d and 46th parallels of north latitude.

LaSalle set out on his expeditions with the expectation of finding that the great river (the Mississippi) which had been partially described to him by the Indians, emptied into the Gulf of California, and he was disappointed when he found that it led into the Gulf of Mexico.

Jean Nicolet came from Cherbourg, France, to Canada, early in the seventeenth century, and entered the service of the fur company known as the Hundred Associates under Champlain. He lived among the Indians and acquired their habits, becoming, like others of his class, fearless and hardy. In a frail canoe, in 1634, he is said to have threaded his way among the isles which extend from Georgian Bay to the extremity of Lake Huron, passed through the straits of Mackinaw, discovered Lake Michigan, and coasted as far south as Green Bay. On his return he said:

“If he had travelled three days more on a large river (probably the Wisconsin), he would have found the sea.”

On the death of Champlain in 1635, the zeal for discovery was checked, but it was rekindled thirty years later by Talon, intendant of police, justice and finance, the first incumbent of that office in Canada. In the summer of 1669, he despatched Louis Joliet and one Pere to search for copper on the shores of Lake Superior, and to discover a more direct route from the upper lakes to Montreal. Joliet went as far as Sault Ste. Marie, but did not remain there long. On his return he met LaSalle at an Iroquois village between Grand river and the head of Burlington Bay, to whom he undoubtedly repeated the stories the Indians had told him of the western country.

Louis de Baude, Count de Frontenac, was appointed governor and lieutenant general of Canada in 1672. Upon the advice of Talon, Frontenac dispatched Joliet on an expedition to the Grand river (the Mississippi), which the Indians had alleged flowed southward to the sea. Such were the circumstances which led to the first organized effort to explore the interior of the western country which resulted in the discovery of the Mississippi, the Illinois and the Desplaines rivers, and the site of the future city of Chicago.

Joliet was the Columbus of this portion of the western world. He has not been given the credit due him for his conception of the commercial advantages which the unexplored country offered, for his intrepidity in facing without hesitation and without adequate means of defense unknown tribes of Indians, for his endurance of untold hardships, and for the persistence with which he accomplished the purpose of his expedition. It is true that Marquette shared the hardships and braved the same dangers, but he accompanied Joliet as a religious instructor only. Marquette sacrificed his life in the noble purpose to establish missions and sow the seeds of civilization among the Indians, but the fate of

Joliet was harder than that of immediate death. Marquette is remembered and honored by the records he has left, but Joliet was robbed in advance of the memory and the honor due him by the loss of his records. Misfortune never dealt a heavier blow and history never lost more important material. The grant of the barren island of Anticosti, in the Gulf of St. Lawrence, for his services was but a mockery of a recompense.

Marquette himself has fixed the place in history which the name of Joliet should occupy, for he says in the opening sentence of his journal: "I embarked with the Sieur Joliet, who had been chosen to conduct this enterprise." Further on he says: "We have had the care to collect from the savages all the knowledge they have of these countries; we have traced a map from their information, the rivers being marked upon it, the name of the nations we shall pass through, and the course that we should be obliged to pursue in this voyage." This was the information that Joliet had prepared, of which fragments only were repeated verbally, and have been preserved. Marquette's narrative relates almost entirely to his efforts to christianize the Indians. Without lowering the name of Marquette on the monument of western discovery, that of Joliet should be lifted into greater prominence.

Louis Joliet, the son of a wagon maker, was born in Quebec. "In boyhood," says Edward D. Neill in Winsor's "Narrative and Critical History of America," "he had been a promising scholar in the Jesuits' school at Quebec, but imbibing the spirit of the times while a young man he became a rover in the wilderness and a trader among the Indians. Three years before his appointment to explore the great river beyond the lakes he had been sent with Pere to search for a copper mine on Lake Superior, and the year before he stood by the side of Saint Lussou as he planted the arms of France at Sault Ste. Marie. It was not until December 8,

1672, that he reached the Straits of Mackinaw, and as the rivers between that point and the Mississippi were by this time frozen, he remained there during the winter and following spring, busy in questioning the Indians who had seen the great river as to its course, and as to the nations on its shores. On May 17, 1673, he began his journey toward a distant sea. At Mackinaw he found Marquette, who became his companion, but had no official connection with the expedition."

These two men set out with two birch bark canoes and five voyageurs. Entering Green Bay they ascended the Fox river and from it dragged their canoes across the narrow portage to the Wisconsin. Down this river they floated, passing into the Mississippi and thence toward the Gulf of Mexico. Near the mouth of the Arkansas they encountered hostile tribes of Indians and decided to return. They were told by friendly Indians that a shorter route to the great lake could be found through a stream which emptied into the river they were traversing and they turned into it. After ascending the stream, Joliet and his companion entered the Illinois river, "which he (Joliet) designated as the Divine, in compliment, it is supposed, to Frontenac's wife, a daughter of Lagrange Trianon, noted for her beauty, and Mademoiselle Outrelaise, her fascinating companion, who were called in court circles 'les divines.' Upon the west bank of one of its tributaries, the Des Plaines river, there stands above the prairie a remarkable elevation of clay, sand and gravel, a lonely monument which has withstood the erosion of a former geologic age. It was a noted landmark to the Indians in their hunting, and to the French voyageurs on their trading expeditions. By this Joliet was impressed, and he gave the elevation his name, Mont Joliet, which it has retained, while all the others he marked on his map have been forgotten." This mound was

about 60 feet high, 225 feet wide, and 1,300 feet long. Only a portion of it remains.

Joliet and Marquette ascended the Desplaines river to the bend at Summit where they dragged their canoes across the portage, a strip of land a mile and a half in width, between the river and a stagnant pond, afterward called Mud lake, from the eastern end of which they entered the stream now known as the Chicago river. Floating down this river they emerged upon Lake Michigan, or the lake of the Illinois, as it was then known, and returned along its western coast to Green Bay. It is suggested by Neill that Joliet may have remained in the vicinity of the mound to which he had given his name during the winter of 1673-4 to trade with the Indians, although Marquette implies in his narrative that Joliet accompanied him to Green Bay. At any rate Marquette stopped at Green Bay to recuperate while Joliet the following year descended the St. Lawrence to bear the report of his discoveries to Count Frontenac. He had been favored by fortune throughout his long and perilous journey, but as he was about to place his papers in the hands of his superior officer his canoe was upset in La Chine rapids, and everything was lost. Two of his men and an Indian boy were drowned, and he narrowly escaped with his own life.

Marquette's journal contains this fragment about the trip up the Illinois river and across the Chicago portage: "After a month's navigation down the Mississippi from the 42d to below the 34th degree, and after having published the gospel as well as I could to the nations I had met, we left the village of Akamsea on the 17th of July to retrace our steps. We accordingly ascended the Mississippi, which gave us great trouble to stem its currents. We left it, indeed, about the 38th degree to enter another river, which greatly shortened our way, and brought us with little trouble to the Lake of the Illinois. We had seen nothing like this

river for the fertility of the land, its prairies, woods, wild cattle, stag, deer, wild cats, bustards, swans, ducks, parrots and even beaver; its many little lakes and rivers. That on which we sailed is broad, and deep and gentle for 65 leagues. During the spring and part of the summer the only portage is half a league."

In October, 1674, Marquette, with two Frenchmen and a number of Illinois and Pottawatomie Indians, attempted to return to the principal town of the Illinois Indians, through which he and Joliet had passed the previous year, his purpose being to establish a mission there. When they reached the Chicago river Marquette was physically unable to proceed and the party encamped for the winter. Their camp was evidently at or near the point where the Illinois and Michigan canal connects with the South branch of the Chicago river. The following extracts are from Marquette's last letter, addressed to Father Dablon, Portage river apparently referring to the Chicago river:

"Dec. 4. We started well to reach Portage river which was frozen half a foot thick."

"Dec. 14. Being cabined near the Portage, two leagues up the river, we resolved to winter there, on my inability to go farther, being too much embarrassed and my malady not permitting me to stand much fatigue."

"Feb. 20. We had time to observe the tide which comes from the lake rising and falling, although there appears no shelter on the lake. We saw the ice go against the wind. These tides made the water good or bad, because what comes from above flows from the prairies and small streams."

"March 30. The north wind having prevented the thaw till the 25th of March, it began with a southerly wind. . . . On the 28th the ice broke and choked above us. On the 29th the water was so high that we had barely time to uncabin in haste, put our things on trees and try to

find a place to sleep on some hillock, the water gaining on us all night; but having frozen a little and having fallen, as we were near our luggage, the dike burst and the ice went down; and as the waters are again ascending already, we are going to embark to continue our route."

"March 31. Having started yesterday, we made three leagues on the river, going up without finding any portage. We dragged for half an arpent. Besides this outlet the river has another (Desplaines) by which we must descend. Only the very highest grounds escape inundation. That where we are (on or near the Desplaines) has increased more than twelve feet. Here we began our portage more than eighteen months ago. . . . The ice still brought down detains us here, as we do not know in what state the river is lower down."

Marquette called the Chicago river Portage river, but it does not seem to have been worthy the distinction of any name for many years afterward. LaSalle speaks of it merely as a "channel formed by the junction of several rivulets, or meadow ditches." The title Chicago, or Checagou, as originally spelled, was bestowed upon the Illinois river, a continuation of the Desplaines. The name Desplaines was given later to the northern branch of the Illinois, so-called because of the maple trees along its banks, which the French Canadians called Plaine. It was then, presumably, the title Checagou was transferred to the present Chicago river, the word meaning strong or mighty, having been originally the name or title of an Indian chief.

In 1812 agents were employed by Governor Ninian Edwards to ascertain the different routes of travel to and from the lakes, and secure other information relating to the country from Mackinaw to St. Louis, to be transmitted to the Secretary of War. Among the notes prepared is the following, which appears to indicate that the name Checagou was moved up the Illinois river before it was entirely

transferred to the present Chicago river: "One and a half leagues higher is the forks of the Quin-que-que. On the south side at this place the Illinois loses its name, and is called from here the Chicago river to the lake, a distance of about twenty leagues." Joliet, as previously stated, gave the name "La Divine" to the Illinois river. He also called it "L'Outrelaise," and the "River of St. Louis." The Mississippi was known as the Colbert, and Lake Michigan as the Lake of the Illinois.

Mud lake is well described by its name, but it deserves a recognition which the name does not suggest. As the waters of Lake Michigan receded in pre-historic times, the Chicago divide, stretching from Summit to Lemont or beyond, became a permanent barrier against the outflow toward the Mississippi, and alluvial deposits formed a second barrier in the vicinity of Bridgeport. In the depression between the Desplaines and Chicago rivers was thus created a pond or lake that stood at the summit of the watershed which separates the St. Lawrence and the Mississippi basins. For its own supply it depended upon the freshets of spring and autumn, its stagnant waters during the remaining months of the year furnishing sustenance for lilies, reeds and marsh grasses, and a home for every variety of the smaller amphibious animals. When its little basin was filled to overflowing it discharged its waters in both directions,—into the Mississippi by way of the Desplaines, and into the St. Lawrence by way of the Chicago river and the great lakes. To Le Petit Lac, as the wandering French Canadians called it, belonged the exclusive distinction of contributing to two of the greatest river systems of the world.

The dimensions of this lake were gradually contracted, and a strip of land varying in width from a mile and a half to three miles separated it from the Desplaines in the time of Joliet, Marquette and LaSalle. By them it

was called the Portage. The Chicago river had its origin at the eastern extremity of Mud lake, not far from the present location of Kedzie avenue. It is less than twenty years since this lake lost its identity, but its former bed was covered with water at every overflow of the Desplaines, until the latter was permanently diverted to a new channel by the Trustees of the Sanitary District in 1893.

Numerous maps embracing the locality were made by the early explorers. Soon after LaSalle's first voyage down the Illinois a map was published by an unknown person. On this map Lake Michigan appears as "*Lac Mitchiganong ou des Illinois.*" Opposite the site of Chicago are the words of which the following is a translation: "The largest vessels can come to this place from the outlet of Lake Erie, where it discharges into Lake Frontenac; and from this marsh, into which they can enter, there is only a distance of a thousand paces to the River La Divine, which can lead them to the River Colbert, and thence to the Gulf of Mexico."

Marquette made a map which was a rude sketch of a portion of Lakes Superior and Michigan and of the route taken by himself and Joliet. The Illinois river appeared on the map, but it was nameless.

A map of greater interest was made by Joliet after his return from the Mississippi, which he presented to Count Frontenac. Following the title is this statement: "Lake Frontenac is separated by a fall of half a league from Lake Erie, from which one enters that of the Hurons, and by the same navigation into that of the Illinois, from the head of which one crosses to the Divine river by a portage of a thousand paces. This river falls into the River Colbert which discharges itself into the Gulf of Mexico."

In the more recent past the condition of the ancient outlet to the Mississippi, or that portion of it nearest to Chicago, is described in a report written by William H. Keating,



who accompanied the Government expedition of Major Stephen H. Long, U. S. A., in 1823. His account shows the interest taken in it even before there was a permanent settlement in this vicinity. He said :

“The South fork of the Chicago river takes its rise about six miles from the fort in a swamp which communicates also with the Desplaines, one of the head branches of the Illinois. Having been informed that this route was frequently travelled by traders, and that it had been used by one of the officers of the garrison, who returned with provisions from St. Louis a few days before our arrival at the fort, we determined to ascend the Chicago river in order to observe this interesting division of waters. We accordingly left the fort on the 7th of June in a boat which, after having ascended the river about four miles, we exchanged for a narrow pirogue that drew less water ; the stream we were ascending was very narrow, rapid, and crooked, presenting a great fall ; it continued so for about three miles when we reached a sort of swamp, designated by the Canadian voyageurs under the name of *Le Petit Lac*. Our course through this swamp, which extended for three miles, was very much impeded by the high grass, reeds, etc., through which our pirogue passed with difficulty. Observing that our progress through the fen was very slow, and the day being considerably advanced, we landed on the north bank, and continued our course along the edge of the swamp for about three miles, until we reached the place where the old portage road meets the current, which was here very distinct towards the south.

“We were delighted at beholding, for the first time, a feature so interesting in itself, but which we had afterwards an opportunity of observing frequently on the route, viz., the division of waters starting from the same source and running in two different directions, so as to become the feeders of streams that discharged themselves into the ocean at

immense distances apart. Although at the time we visited it there was scarcely water enough to permit our pirogue to pass, we could not doubt that in the spring of the year the route must be a very eligible one. Lieut. Hopson, who accompanied us to the Desplaines, told us that he had travelled it with ease in a boat loaded with lead and flour. The distance from the fort to the intersection of the Portage road and Desplaines is supposed to be about twelve or thirteen miles. The elevation of the feeding lake above the Chicago river was estimated at five or six feet, and, it is probable that the descent to the Desplaines is less considerable. The Portage road is about eleven miles long ; the usual distance travelled by land seldom, however, exceeds from four to nine miles ; in very dry seasons, it has been said to amount to thirty miles, as the portage then extends to Mount Joliet, near the confluence of the Kankakee.

“ When we consider the facts above stated, we are irresistibly led to the conclusion, that an elevation of the lakes of a few feet (not exceeding ten or twelve) above their present level would cause them to discharge their waters, partly at least, into the Gulf of Mexico ; that such a discharge has at one time existed every one conversant with the nature of the country must admit ; and it is especially apparent that an expenditure, trifling in comparison to the importance of the object, would again render Lake Michigan a tributary of the Mexican Gulf.”

There were seasons apparently when the upper part of the channel of the Chicago river was dry, and there were two portages instead of one. A “rough draft” of a memorandum dated December, 1718, designed to aid Governor Keith of Pennsylvania in preparing a memorial to the British Board of Trade, says: “From Lake Huron they pass by the Strait of Michilimakinac four leagues, being two in breadth and of great depth, to the Lake Illinois; thence 150 leagues on the lake to Fort Miami, situated at

the mouth of the River Chicagou. This Fort is not regularly garrisoned. From hence came those Indians of the same name, viz., Miami, who are settled on the forementioned river that runs into Erie. Up the River Chicagou they sail but three leagues to a portage of a quarter of a league; they then enter a very small lake of about a mile and have another very small portage; thence down the same 130 leagues to the Mechasipi."

CHAPTER VIII.

FIRST SUGGESTIONS OF A WATERWAY.

Joliet's commercial instincts foresaw the advantages of a continuous waterway from Lake Michigan to the Mississippi. The purpose of his expedition was to determine whether the Grand river, of which the French Canadians had received indefinite information from the Indians, led across the continent. If there was any disappointment in finding that it did not there was an unexpected compensation in the discovery of a fertile country in the valley of the great river, and the easy means of reaching it through the combination of streams connecting it with Lake Michigan. To Joliet belongs the credit of the first suggestion of a restored waterway from the great lake to the Grand river. As his records were lost the only information which can be had from him comes through another person. Father Dablon, to whom Joliet gave a verbal account of his journey and discoveries, says in a letter written August 1, 1674, reporting what Joliet had said:

“The fourth remark concerns a very important advantage, and which some will, perhaps, find it hard to credit; it is, that we can quite easily go to Florida in boats, and by a very good navigation. There would be but one canal to make, by cutting only one-half a league of prairie, to pass from the Lake of the Illinois into St. Louis river. The route to be taken is this: the bark should be built on Lake Erie, which is near Lake Ontario; it would pass easily from Lake Erie to Lake Huron, from which it would enter the Lake of the Illinois. At the extremity of this lake

would be the cut or canal of which I have spoken, to have a passage to St. Louis river, which empties into the Mississippi. The bark having entered this river, could easily sail to the Gulf of Mexico. . . . The fifth remark regards the great advantages there would be in founding new colonies in such beautiful countries and such fertile soil. Hear what *Sieur Joliet* says: 'When they first spoke to us of these lands without trees, I figured to myself a burned-up country, where the soil was so wretched that it would produce nothing. But we have seen the reverse, and no better can be found either for wheat, or the vines, or any fruit whatever. The river to which we have given the name of St. Louis, and which has its source not far from the extremity of the Lake of the Illinois, seemed to me to offer on its banks very fine lands well suited to receive settlements. The place, by which after leaving the river you enter the lake, is a very convenient bay to hold vessels and protect them from the wind.' "

Frontenac wrote the French government on November 14: " *Sieur Joliet*, whom *Monsieur Talon* advised me, on my arrival from France, to despatch for the discovery of the South Sea, returned three months ago, and found some very fine countries and a navigation so easy through the beautiful rivers, that a person can go from Lake Ontario and Fort Frontenac in a bark to the Gulf of Mexico, there being only one carrying place, half a league in length, where Lake Ontario communicates with Lake Erie. . . . He has been within ten days journey of the Gulf of Mexico, and believes that water communication could be found leading to the Vermillion and California seas, by means of the river that flows from north to south, and is as large as the St. Lawrence opposite Quebec. "

La Salle was not favorably impressed with the idea of a water communication between Lake Michigan and the Mississippi by way of the Chicago valley; the fact that he

usually passed over the route afforded by the St. Joseph and Kankakee rivers to the Illinois indicates a prejudice against the former. At any rate, he questioned the feasibility of an artificial waterway between Lake Michigan and the Illinois river, and on his return to Canada in 1680 he replied to the suggestions made by Joliet in somewhat obscure but forcible language. It is likely this was prompted by a jealousy engendered by Joliet's priority of discovery ; it is certain that an attempt was made a few years later to rob Joliet of the credit belonging to him. An unknown person is said to have heard from LaSalle himself in France, long after it was published to the world that Joliet had discovered the upper Mississippi and the Illinois, that he, LaSalle, had descended the Ohio to the Mississippi and returned by way of the Illinois. This is not generally believed to be true. But it is seen that the controversy over the desirability of connecting the great lakes with the Mississippi began at a very early day. Recalling the words of LaSalle, he said in a memoir to Count Frontenac, written November, 9, 1680 :

“The basin into which you enter to go from the Lake of the Illinois to the Divine river is no way suited for communication, there being no anchorage, wind, or entrance for a vessel, nor even a canoe, except in a great calm; the prairies by which a communication is spoken of being flooded whenever it rains by the waters from the neighboring hills. It is very difficult to make and keep up a channel there that will not at once fill up with sand and gravel ; and you cannot dig into the ground without finding water ; and there are sand hills between the lake and the prairies. And were this channel possible, at great expense, it would be useless, because the Divine river is not navigable for forty leagues from there to the great village of the Illinois. Canoes cannot pass there in summer ; and there is even a great rapid this side of the village.”

In a fragment of a letter written by LaSalle, without date, but evidently after the communication to Frontenac, the great explorer says : " I sent M. de Tonty in advance with all my people, who, after marching three days along the lake, and reaching the division line called Checagou, were stopped, after a day's march along the river of the same name, which falls into the Islinois, by the ice, which entirely prevented further navigation. This was the 2nd and 3rd of January, 1682. I remained behind (at the St. Joseph river) to direct the making of some caches in the earth of the things I left behind. . . . Having finished my caches, I left the 28th of December, and went on foot to join the Sieur de Tonty, which I did the 7th of January, the snow having detained me some days at the portage of Checagou. This is an isthmus of land at 41 degrees, 50 minutes north latitude at the west of the Islinois Lake, which is reached by a channel formed by the junction of several rivulets, or meadow ditches. It is navigable for about two leagues to the edge of the prairie, a quarter of a league westward. There is a little lake divided by a causeway made by the beavers, about a league and a half long, from which runs a stream which, after winding about a half league through the rushes, empties into the river Checagou, and thence into that of the Islinois. This lake is filled by heavy summer rains, or spring freshets and discharges also into the channel which leads to the Lake of the Islinois, the level of which is seven feet lower than the prairie on which the lake is.

"The river of Checagou does the same thing in the spring when its channel is full. It empties a part of its waters by this little lake into those of the Islinois, and at this season, Joliet says, forms, in the summer time, a little channel for a quarter of a league from this lake to the basin which leads to that of the Islinois, by which vessels can enter the Checagou and descend to the sea. This may very well happen

in the spring but not in the summer, because there is no water at all in the river as far as Fort St. Louis, where the Islinois begins to be navigable at this season, whence it continues to the sea. It is true that there is still another difficulty which the proposed ditch would not remedy, which is that the lake of the Islinois always forms a sand bar at the mouth of the channel which leads to it; and I greatly doubt, notwithstanding what is said, that it could be cleared or swept away by the force of the current of the Checagou, since a much greater, in the same lake, has not removed it. Moreover, the utility of it would be inconsiderable, because I doubt, even if it should be a complete success whether a vessel could resist the great freshets caused by the currents in the Checagou in the spring, which are much heavier than those in the Rhone. Moreover, it would only be serviceable for a short time, and at most for fifteen or twenty days each year, after which there would be no more waters. What confirms me in the opinion that the Checagou could not clear the mouth of the channel is, that when the lake is full of ice, the most navigable mouths are blocked at this period; and when the ice is melted, there is no more water in the Checagou to prevent the mouth from filling up with sand. Nor should I have made any mention of this communication if Joliet had not proposed it without regard to its difficulties.

“Moreover, I maintain that even should such a communication between Louisiana and New France be desired, it is too difficult by way of the lakes because of the diversity of the winds to which their situation exposes them, the furious gales that must always be encountered near land on account of their narrowness of the waters and want of depth or anchorage in case of necessity. The channel between Lake Erie and Huron presents a great difficulty because of its great current, which cannot be surmounted except by a strong stern wind, and because there are places between

there is only a width of four feet of water, so that vessels capable of supporting the storm of the lakes could scarcely pass, for, whether because of the height of their situation on the mountains of Niagara, or the nearness of other mountains by which they are almost wholly surrounded, the autumn and spring storms are so furious, so sudden, and so long, particularly furious from the northwest and northeast, and from the southeast in the spring, that sometimes for three or four days it would be impossible to carry sail or keep clear of the land, which is never more than fifteen or sixteen leagues distant, the lakes being no more than thirty leagues wide; and because if this communication should be insisted upon by means of barques, the lakes could not be navigable before the middle of April, and sometimes even later, because of the ice and winter at this season; nor for the rest of the year is the Checagou navigable, even for canoes, unless after a storm. The water being always low in the month of March it would be easier to effect the transportation from Fort St. Louis to the lakes by land by using horses, which it is easier to have, there being numbers among the savages called Pana, etc., etc. . . . This is what I have to say concerning this passage by which Joliet pretended an easy communication could be had with Louisiana."

For the next hundred years dreams of commercial possibilities were smothered by struggles for existence. Wars with the Indians were followed by wars among the different nationalities inhabiting the country and then by the Revolution. Nothing more was heard about the feasibility of a water route from Lake Michigan to the Mississippi until August 3, 1795, when a treaty of peace was concluded with the Indians, "to put an end to a destructive war to settle all controversies, etc." For a "consideration" the aborigines ceded to the United States fourteen pieces of land, one of which, six miles square, was "at the mouth of the Chi-

kago River, emptying into the southwest end of Lake Michigan, where a fort formerly stood." Then followed this clause, which may be considered the first official suggestion of a canal across the Chicago Divide: "And the said Indian tribes will allow to the people of the United States a free passage by land and by water, as one and the other shall be found convenient, through their country, along the chain of posts hereinbefore mentioned, that is to say, . . . Again from the mouth of Chikago to the commencement of the portage between that river and the Illinois and down the Illinois River to the Mississippi."

In 1817 Samuel A. Storrow, judge advocate of the United States army, made a three months' tour through the west. An account of his trip appears in a letter to Major General Brown, dated December 1, of that year. He speaks of the Chicago river as deep and about forty yards wide. His attention was attracted to the interesting fact of the division of the waters at its source, part flowing eastward to the lake and part westward to the Mississippi, and he commented on the practicability of a permanent waterway. He says:

"Before it (the river) enters the lake its two branches unite, the one proceeding from the north, the other from the west, where it takes its rise in the very fountain of the Plein, or Illinois, which flows in an opposite direction. The source of these two rivers illustrates the geographical phenomenon of a reservoir on the very summit of a dividing ridge. In the autumn they are both without any apparent fountain, but are formed within a mile and a half of each other by some imperceptible undulations of the prairie which drain it and lead to different directions. But in the spring the space between the two is a single sheet of water, the common reservoir of both, in the center of which there is no current towards either of the opposite streams. This circumstance creates the singular fact of the insulation

of all the United States excepting Louisiana, making the circumnavigation of them practicable from the Gulf of St. Lawrence to that of Mexico, with the single hindrance of the falls of Niagara. The Chicago forms a third partition of the great country I had passed. The Ouisconsin and Fox rivers make a water communication between the Mississippi and Michigan, with the exception of four miles. The Millewackie and River a la Roche, the same, with half the exception. The Chicago and De Plein make, in the manner I have described, the communication entire. The latter should not escape national attention. The ground between the two is without rocks, and with little labor would admit of a permanent connection between the waters of the Illinois and Michigan."

Storror's observations could not have extended beyond the portage between Mud lake and the Desplaines river, where he saw no indication of a rock formation. But his statement was correct when he said: "Fort Dearborn has no advantages of harbour, the river itself being always choaked and frequently barred from the same causes that I have imputed to the other streams of this country." The obstructions referred to were sandbars.

As the idea of a navigable waterway between Lake Michigan and the Mississippi rolled through the minds of the thinking men in the early part of the present century, it acquired increasing importance. It was not too much to hope for a passage way for any vessel that traversed either lake or river. St. Louis was already a considerable town, and an artificial channel which would discharge the waters of Lake Michigan westward was enthusiastically advocated by its editors and speakers.

In 1818, William Darby, an author of prominence in the East, made a tour through the West. His notes were published in the following year. They contain the following paragraph:

“No doubt now remains but that the Chicago and Illinois rivers afford by far the most eligible natural connexion between the northern and the southern waters of the United States. It appears that the great spine running from the Hudson to the Maumee river terminates at or is interrupted by the valley of the Illinois. The latter stream is formed towards its source by two branches, one of which rises south of Lake Michigan, and the other (River Plein) rises in the flat country west of Chicago, and flowing south, unite to the southwest of the extreme south part of Michigan. The Chicago heads in the same plain with the River Plein, and winding for some distance parallel to the latter stream, thence turns east, falls into Lake Michigan. The Chicago and Plein intermingle their sources, and afford one of those instances where rivers have their sources in plains so nearly approaching the curve of a real sphere as to leave, for the discharge of the waters, scarce inclination sufficient to determine their courses. This is the case with the two rivers we are now reviewing. The precise descent of the Chicago, from its nearest approach to the Plein to the level of Lake Michigan, has never been ascertained, but it is known to be without falls, or even rapids. The Plein also flows with a very slight current, and the two streams present almost a strait between the Mississippi river and Lake Michigan. The land contiguous to this important pass was ceded to the United States by the savage tribes who formerly possessed the right of soil. The land thus ceded is now about being surveyed and in course will, ere long, be sold to individuals and settlers. The development of the natural sources of this region will be disclosed with the ordinary celerity that marks the newly established settlements in our western world. . . . If the people of the United States ought ever to unite in opening any channel of communication it is that by the Illinois river and Lake Michigan. If the various points from St. Louis to Buffalo were united

by commercial facility, a numerous population would be the immediate consequence."

In 1816 the Ottawa, Chippewa, and Pottawatomie Indians ceded to the United States a strip of land twenty miles in width from Chicago to Ottawa, embracing the valley of the Desplaines and Illinois rivers. Two years later surveyors were sent out to locate the boundary lines, one beginning ten miles north and the other ten miles south of Chicago. Commenting on this work, as the surveyors set out from St. Louis, the *Enquirer* of that city gave the following information as to the extent of navigation through the valley at that time and the means of crossing the portage in dry weather:

"The communication between the lake and the Illinois is a point which will fix the attention of the merchant and the statesman. They will see in it the gate which is to open the northern seas into the valley of the Mississippi and which is to connect New York and New Orleans by a water line, which the combined navies of the world cannot cut off. Never did the work of nature require so little from the hand of art to complete so great a design. The Lakes Superior, Huron, Erie and Ontario lie from west to east, in the direction of the St. Lawrence, manifestly seeking their outlet through the valley of that river. But the Michigan departs from that direction; she lies from north to south. United to the other lakes by a strait, she stretches the body of her water towards the head of the Illinois river, as if intending to discharge herself through that channel into the Mississippi. And no hills or mountains intervene to prevent the conjunction; on the contrary, the ground between is flat and covered with ponds in wet weather which turn their waters partly to the lake and partly to the river. The Chicago and the Plein are the drains from these ponds; they have neither falls nor shoals; they have not the character of streams, but of canals; the water hardly moves

in their deep and narrow channels. The Illinois itself is more a canal than a river, having hardly current enough to bend the lofty grass which grows in its bed.

“The French of Canada and of the valley of the Mississippi have communicated through the channel since the settlement of the countries. In high water boats of ten or a dozen tons pass without obstruction. In the dry season, they are unloaded, placed on vehicles and drawn by oxen over a portage of a few miles and launched into the river or lake, as the course of the voyage may require. Hundreds, nay thousands, of boats have been seen at St. Louis which have made a similar passage. It may be hoped that the Government will not limit itself to the barren work of marking the lines about this portage. While the state of New York opens a canal of three hundred miles, the Federal Government should not be appalled at undertaking one of three hundred rods. It might be dug in the time that a long-winded member of Congress would make a speech against its constitutionality.”

The few permanent settlers at the mouth of the Chicago river at the time St. Louis was agitating the construction of a canal, had no influence and their interests were hardly taken into consideration. As late as 1836, the year in which work on the Illinois and Michigan canal began, Chicago had a population of only 3,820. But the East never lost sight of the benefits it would derive from a water communication with the valley of the Mississippi, and the National Government was repeatedly urged to develop it. A fair illustration of the feeling in the East is shown by a quotation from a letter written by C. F. Hoffman of New York, editor of the *Knickerbocker Magazine*. Mr. Hoffman made a trip to the West, reaching Chicago in the latter part of 1833. Writing from Chicago under date of January 10, 1834, he says:

“There is one improvement to be made, however, in

this section of the country, which will greatly influence the permanent value of property in Chicago. I allude to a canal from the head of Lake Michigan to the head of steam navigation on the Illinois, the route of which has been long since surveyed. The distance to be overcome is something like ninety miles; and when you remember that the head waters of the Illinois rise within eleven miles of Chicago river, and that a level plain of not more than eight feet elevation above the latter is the only intervening obstacle, you can conceive how easy it would be to drain Lake Michigan into the Mississippi by this route, boats of eighteen tons having actually passed over the intervening prairie at high water. Lake Michigan, which is several feet or more above Lake Erie, would afford a never-failing body of water that would keep steamboats afloat on the route in the driest season. St. Louis would then be brought comparatively near to New York, while two-thirds of the Mississippi valley would be supplied by this route immediately from the markets of the latter.

“This canal is the only remaining link wanting to complete the most stupenduous chain of inland communication in the world. I had a long conversation this morning with Major H., the United States engineer who is engaged in superintending the construction of a pier at this place. He was polite enough to sketch the main features of the route with his pencil in such a manner as to make its feasibility very apparent. The canal would pass for the whole distance through a prairie country where every production of the field and the garden can be raised with scarcely any toil, and where the most prolific soil in the world requires no other preparation for planting than passing the plough over its bosom. The most effectual mode of making this canal would be to give the lands along its banks to an incorporated company, who should construct the work within a certain time. The matter is now merely agitated at elections as a political handle.”

CHAPTER IX.

CONGRESS AND INTERNAL IMPROVEMENTS.

Western interests were almost entirely neglected by the National Government prior to the year 1807. The West was as distant from the East as though they were separated by an ocean, and those who were bold enough to cross the Allegheny mountains did so with the full understanding that they were penetrating an unknown country and might never return to civilization. The first steamboat was launched on the Hudson river in 1807 and its successful operation at once suggested a means of profitable navigation on the large rivers in the interior of the country. A new impulse was given to emigration to the West, and out of the conditions it created sprang the idea of providing better means of communication with the new world in the valleys of the Ohio and the Mississippi. Prior to this time the West had been taxed for the benefit of the East, as all the money raised by the National Government had been spent in the improvement of harbors, building lighthouses and the execution of other public works along the seacoast. It had not been many years since the East itself demonstrated the fact that there could not be taxation of a free people without representation, and it was quick to suggest that the West, now developing a strength which was really feared, should have a share in the benefits of a national existence. Thus began the system of internal improvements which created good roads, built canals and improved the rivers of the West.

The first to suggest specific action by the National Gov-

ernment along the line of internal improvements was Thomas Worthington of Ohio, who moved in the United States Senate on March 2, 1807, that "the secretary of the treasury be directed to prepare and report to the Senate at their next session a plan for the application of such means as are within the power of Congress to the purposes of opening roads and making canals, together with a statement of the undertakings of that nature which, as objects of public improvement, may require and deserve the aid of Government ; and also a statement of works of the nature mentioned which have been commenced, the progress which has been made in them and the means and prospect of their being completed, and all such information as, in the opinion of the secretary, shall be material in relation to the objects of the resolution."

Complying with this order Albert Gallatin, secretary of the treasury, made a report on roads and canals to the Senate on April 6, 1808. This was a very complete statement of the condition of the roads and canals then in existence or in preparation and contained definite plans for a system of internal improvements. "The inconveniences, complaints, and perhaps dangers, which may result from a vast extent of territory," he said, "can no otherwise be radically removed or prevented than by opening speedy and easy communication through all its parts. Good roads and canals will shorten distances, facilitate commercial and personal intercourse and unite by a still more intimate community of interests the most remote quarters of the United States. No other single operation within the power of Government can more effectually tend to strengthen and perpetuate that union which secures external independence, domestic peace and internal liberty."

Referring to the natural communication between Lake Michigan and the Mississippi he said of the Illinois river, that it "rises in a swamp which, when the waters are high,

affords a natural canoe navigation to the sources of Chicago creek, a short stream, which falls into Lake Michigan at its southern extremity." He did not doubt that if the inland navigation between the western rivers and the lakes was completely opened the whole Indian trade, either of the Mississippi by Lake Michigan, or of the Northwest by Lake Superior, must necessarily center in an Atlantic port of the United States, a consideration of minor importance as a commercial object when compared with the other advantages of that great communication, but of great weight in its relation to the political intercourse of the United States with the Indians. His estimate of the cost of the improvements to reach Lake Michigan was \$16,600,000; to reach the Mississippi, \$20,000,000. To raise this sum he suggested that the Government sell ten million of its one hundred million acres of public lands. He believed the increase in the value of the remaining ninety million acres would more than repay the outlay. His report was referred to a committee and a week later 1,200 copies were ordered printed. That was the only official recognition it received, probably because Congress was in daily fear that it would exceed its constitutional powers.

In spite of his sensitiveness over the rights of the states and the limitations of the powers of the General Government, Thomas Jefferson, in his message to the Tenth Congress on November 8, 1808, guardedly suggested that the surplus of revenue, beyond what could be applied to the payment of the public debt, should be devoted to internal improvements.

In the House on December 27, 1809, John Nicholson of New York introduced a resolution providing that a select committee be appointed to inquire into the expediency of making permanent provision by law for constructing public canals and roads. This resolution was at once laid on the table.

In the Senate on January 5, 1810, a bill introduced by John Pope of Kentucky received some consideration. This provided that when any company incorporated in one or more states for constructing canals and roads had sold one-half of its stock the United States might subscribe for any part or all of the remainder. To pay for the stock, certificates were to be issued, bearing interest at the rate of six per cent. To provide for the payment of these certificates the proceeds of the sale of public lands west to Lake Michigan were to be appropriated. This bill passed to the second reading, but amendments proposed by the select committee to whom it was referred were rejected, and further consideration was postponed. Nothing further was heard of the bill.

In the House on February 8, 1810, Peter B. Porter of New York rose to discuss the internal improvements of the United States by roads and canals. He said he had listened to appeals for the protection of commerce. It was to be presumed that Congress would be as willing to give a direct encouragement to agriculture as to do it indirectly through the medium of commerce. He referred to the bill introduced in the Senate by Mr. Pope, in the preparation of which he had had a part. Some great system of internal navigation, such as was contemplated in that bill, was not only an object of the first consequence in the future prosperity of the country, considered as a measure of political economy, but as a measure of state policy it was indispensable to the preservation of the integrity of the Government. For twenty years the United States had been favored in external commerce in a manner unequalled. Their citizens had not only grown rich, but they had almost gone mad in the pursuit of this commerce. This was owing in part to the unparalleled succession of events in Europe. The course of events had now materially changed and with it the tide of this country's commercial prosperity. He was far

from believing that this might not eventually prove fortunate to the people of the United States.

One of the objects of the system he was about to propose was to unlock the internal resources of which the country found itself possessed, to enable the citizen of one part of the United States to exchange his products for those of another, and to open a great internal commerce which was acknowledged by all who professed any skill in the science of political economy to be much more profitable and advantageous than the most favored external commerce. The system had another object in view not less important. "The people of the United States are divided," he said, "by a geographical line into two great and distinct sections, the people who live along the Atlantic on the east side of the Allegheny mountains, and who compose the three great classes of merchants, manufacturers and agriculturists, and those who occupy the west side of those mountains, who are exclusively agriculturists. This diversity and supposed contrariety of interest and pursuit between the people of these two great divisions of the country, and the difference of character to which these occupations give rise, it has been confidently asserted and is still believed by many, will lead to a separation of the United States at no very distant day. In my humble opinion, sir, this very diversity of interest will, if skillfully managed, be the means of producing a closer and more intimate union of the States." By producing a mutual dependence between these great sections and by these means only could the United States be kept together.

There was no market for the products of the West, he continued. The disastrous effects were seen on the industry and the morals of its people. Their increase in numbers and the ease with which their children were brought up and fed, far from encouraging them to become manufacturers, put at a great distance the time when, quitting the freedom

and the independence of the soil, they would submit to the labor and confinement of manufactures. It became an object of national importance, outweighing almost any other that could occupy the attention of the House, to inquire whether the evils incident to this state of things might not be removed by a great navigable canal from the Atlantic to the western states, thus promoting the natural connection and intercourse between the farmer and the merchant, so highly conducive to the interests of both.

Proceeding to show by geographical detail both the importance and the practicability of such navigation, he found west of the Alleghenies "a scene of natural internal navigation unequalled in the world." To the south and the west of the great lakes "the waters of the Ohio and the Mississippi approach within short distances of and are interlocked by the waters of the lakes. The lands along these dividing waters are generally level, and the rivers are navigable and might be connected by short canals at little expense. At the southwestern extremity of Lake Michigan, the most inconsiderable expense would open a canal between the waters of that lake and the Illinois river, one of the principal branches of the Mississippi. Nature has already made this connexion nearly complete, and it is not uncommon for boats in the spring of the year to pass from the lake into the Illinois and from thence by the waters of the Illinois and Mississippi to New Orleans without being taken out of the water."

The effect of a canal system would be to reduce the prices of manufactured articles to the people of the West and increase the prices of the public lands. The United States owned about 250,000,000 acres of land in the western country, independent of Louisiana. More than 100,000,000 acres of this was in the vicinity of the great lakes, 50,000,000 of which were within thirty miles of the lakes. To appropriate 1,000,000 acres for the construction

of a canal from the Atlantic to the lakes would enhance the value of the remaining 49,000,000 acres some hundreds per cent. Canals and roads would increase the duties on imports and be a military advantage. They would enable the western settlers to pay their debts to Congress.

“Every motive of interest and policy,” said Mr. Porter, “unites in urging the Government to undertake this system of internal improvement. It is a subject too vast to be accomplished by individual enterprise. The means of the citizens of the western country are peculiarly inadequate to such an undertaking. They cannot construct canals, for the very obvious reason that they are already deeply in debt for their lands, and they must continue so until this great work is executed for them. They will not only be able to pay you for their lands, but they will remunerate you for the expense of opening canals by the tolls which they will be able to pay. In the advantages which these outlets for their produce will give them, and on which their prosperity must so essentially depend, you will have a pledge for their future attachment and fidelity to your Government which they will never forfeit. But, sir, if you neglect to avail yourselves of the opportunity which this system affords of securing the affections of the western people,—if you refuse to extend to them those benefits which their situation so imperiously demands, and which your resources enable you and your duty enjoins it on you to extend to them,—if, while you are expending millions yearly for the encouragement of commerce, you affect constitutional doubts as to your right to expend anything for the advancement of agriculture,—if you can constitutionally create banks for the accommodation of the merchant, but cannot construct canals for the benefit of the farmer,—if this be the crooked, partial, sideway policy which is to be pursued, there is great reason to fear that our western brethren may soon accost us in a tone higher than that of

the Constitution itself. They may remind us (as the people of this country once did another power which was regardless of their interests) of the rights of which the God of nature has invested them by placing them in the possession of a country which they have the physical power to defend, and which it is to be feared they would defend against all the tax gatherers we could send among them, supported by all the force of the Atlantic states."

Mr. Porter submitted a resolution providing for the appointment of a committee to examine into the expediency of appropriating a part of the public lands, or the proceeds of their sale, to the construction of such roads and canals, as might be most conducive to the general interests of the Union. The resolution was adopted and a committee of twenty members, with Mr. Porter as chairman, was at once appointed. On February 23, 1810, Mr. Porter, for his committee, reported a bill essentially the same as the one introduced in the Senate by Mr. Pope. This was read twice and referred to the committee of the whole. Its fate seems to have been the same as that of Pope's bill in the Senate.

During the second war with Great Britain, the question of internal improvements received little consideration. In the early part of the year 1812, memorials were presented to Congress, soliciting aid for local improvements, among them one from the commissioners of the State of New York, respecting a canal from the Great Lakes to the Hudson river. The committee to whom these were referred reported on February 20, lamenting that the inauspicious situation of the United States in regard to foreign relations rendered it improper at that time "to grant that effectual aid to the undertaking to which they are so well entitled." Accompanying the report was a letter from Gallatin, still secretary of the treasury, who said the state of the finances of the country would not permit the proposed application of moneys to any new objects of improvement. But lands

might be donated, the proceeds of the sales to be anticipated by authorizing loans. He believed that a system of improvements embracing all the important communications pointed out by the great geographical features of the country would have a most powerful effect toward promoting the prosperity of the country, and consolidating the interests of the most remote quarters of the union. The memorials and the report were referred to the committee of the whole and dropped.

In the House, on April 2, 1814, Thomas Wilson of Pennsylvania submitted a resolution providing that a select committee be appointed to inquire into the expediency of a provision by law for the progressive improvement of the routes of communication by land and inland navigation throughout the United States and the territories upon the principles and general plan contained in Gallatin's report, to be carried into effect as soon as might be practicable after the termination of the war in which the United States were then engaged. The resolution was ably supported by Mr. Wilson, but it was tabled.

President Madison in his annual message of December 5, 1815, called the attention of Congress to the great importance of establishing throughout the country the roads and canals which could be best executed under the national authority. The committee to whom this part of the message was referred reported on February 6, 1816. Resolutions were introduced providing for the annual appropriation of a blank sum to constitute a fund for making roads and opening canals, the fund to be under the direction of the secretary of the treasury, who, when authorized by Congress, should subscribe for stock. The resolutions reached a third reading and were then indefinitely postponed.

In the House on December 16, 1816, John C. Calhoun of South Carolina moved that a committee be appointed to inquire into the expediency of setting apart the bonus and

the net annual proceeds of the national bank as a permanent fund for internal improvement. The motion was carried and a committee was appointed, with Mr. Calhoun chairman. The committee reported a bill on December 23, embodying the idea Mr. Calhoun had advanced, and the bill was passed on February 8, 1817. It went to the Senate two days later and was passed by that body on February 28. President Madison vetoed the bill on March 3, maintaining that Congress had no constitutional power to make such an appropriation. An unsuccessful effort was made to pass the bill over the veto.

President Monroe, like his predecessor, found no authority in the Constitution for the use of the public moneys in the construction of canals and roads. In his first message to Congress on December 2, 1817, he said of the right of Congress to establish such a system of improvements: "Disregarding early impressions, I have bestowed on the subject all the deliberation which its great importance and a just sense of my duty required, and the result is a settled conviction in my mind that Congress do not possess the right. It is not contained in any of the specified powers granted to Congress, nor can I consider it incidental to or a necessary mean, viewed on the most liberal scale, for carrying into effect any of the powers which are specifically granted." He recommended that an amendment to the constitution giving Congress the necessary power be submitted to the States. Such an amendment was proposed in the Senate on December 9, by James Barbour of Virginia. On March 26 the matter was indefinitely postponed.

The constant reverses which attended the agitation of the question of internal improvements were arrested finally by the bold action of the House which expressed its dissent from the views of President Monroe in a very emphatic manner. On December 15, 1817, Henry St. George Tucker of Virginia, for the committee appointed to

consider that part of the President's message relating to roads and canals, reported that Congress had the power to construct roads and canals through the several States, on such terms as might be agreed upon, leaving the jurisdictional rights in the States respectively. The debate which followed occupied the time of the House for many days. At last, on March 14, 1818, the following resolution came to a vote and was passed: "That Congress has power, under the Constitution, to appropriate money for the construction of post roads, military and other roads, and of canals, and for the improvement of water courses."

From this date until about 1830, through the aid of the General Government, though not without frequent interruption, internal improvements were carried forward in every part of the country. One result was a rapidly increasing emigration to the West. Subsequent acts of Congress relating to this subject were confined mainly to specific grants.

Although no direct action was taken by the National Government to improve the means of communication between the East and the West before the year 1807, the question had been agitated before that date. There is evidence that an attempt was made in the Convention of 1787 to provide for internal improvements, but it was abandoned through fear that it would defeat the adoption of the Constitution. As early as June 18, 1786, Washington wrote to Richard Henry Lee, referring to the navigation of the Mississippi: "It is neither to relinquish nor to push our claim to this navigation, but in the meanwhile to open all the communications which nature has afforded between the Atlantic states and the western territory, and to encourage the use of them to the utmost. In my judgment, it is a matter of very serious concern to the well being of the former to make it the interest of the latter to trade with them; without which the ties of consanguinity, which are weakening

every day, will soon be no bond, and we shall be no more a few years hence to the inhabitants of that country than the British and the Spaniards are at this day; not so much, indeed, because commercial connexions, it is well known, lead to others, and united are difficult to be broken, and these must take place with the Spaniards, if the navigation of the Mississippi is opened."

Again, on July 19, 1787, six days after the adoption of the Ordinance of 1787, Washington wrote to Lee: "I have ever been of the opinion that the true policy of the Atlantic states would be, instead of contending prematurely for the free navigation of that river (which eventually, and perhaps as soon as it shall be our true interest to obtain it must happen), to open and improve the natural communications with the western country, through which the produce of it might be transported with convenience and ease to our markets."

CHAPTER X.

GOVERNMENT AID OF THE ILLINOIS AND MICHIGAN CANAL.

Repeated reference to the importance of a canal communication between Lake Michigan and the Illinois river, in the many years of congressional discussion and attempted legislation in the line of internal improvements, was an acknowledgment of its national character. No link in the chain of commercial advantages was more important than this, since it was on the great highway from the manufacturing East to the agricultural West.

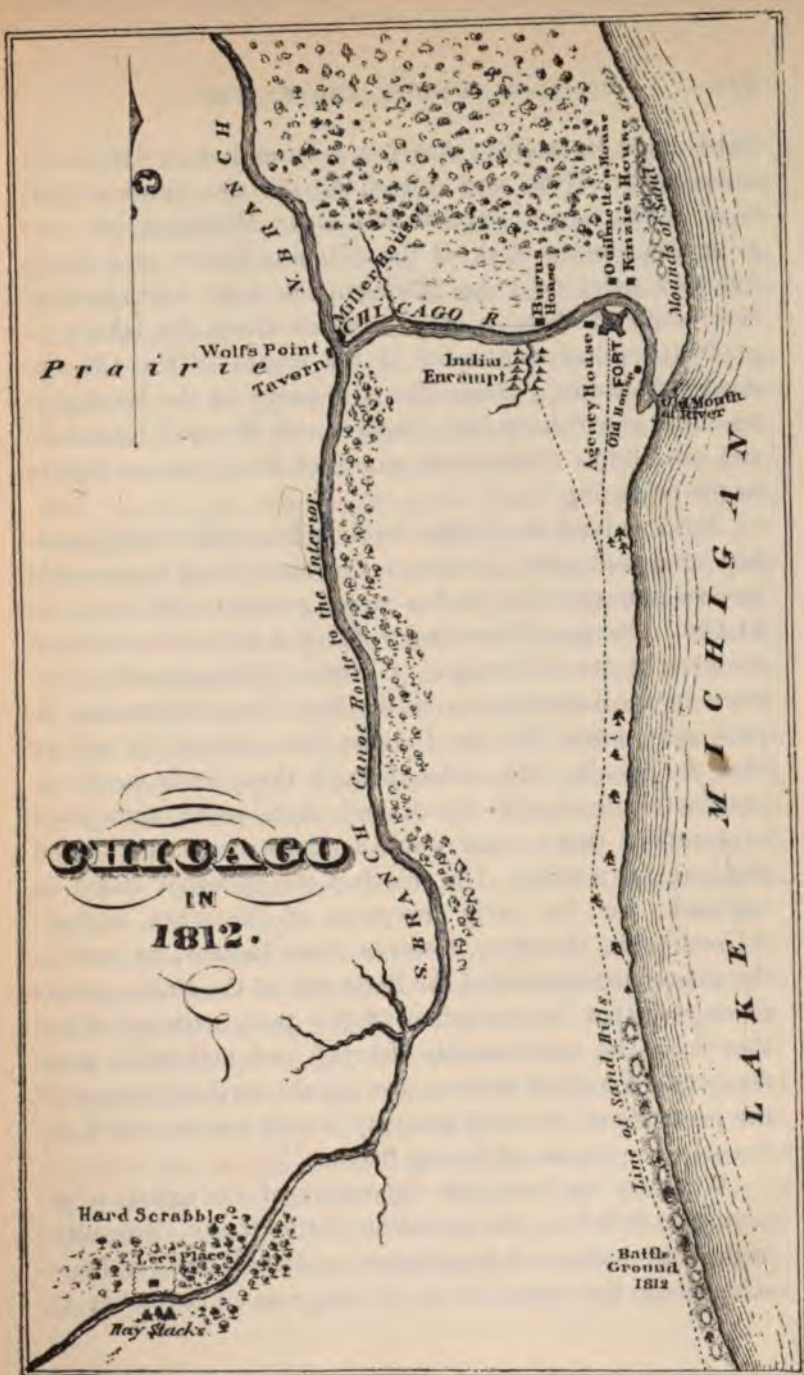
The speeches made in the National Legislature indicate the prevailing sentiment, but the following paragraph from an editorial in *Niles' Register*, of August 6, 1814, published in Baltimore, shows an exuberance of feeling: "By the Illinois river it is probable that Buffalo may be united with New Orleans by inland navigation through Lakes Erie, Huron and Michigan and down that river to the Mississippi. What a route! How stupendous the idea! How dwindles the importance of the artificial canals of Europe compared with this water communication! If it should ever take place the territory of Illinois will become the seat of immense commerce and a market for the commodities of all regions."

John C. Calhoun, when secretary of war, suggested to Congress in a report made on January 14, 1819, a plan for the application of such means as were within the power of Congress for the purpose of opening and constructing roads and canals that might deserve and require the aid of the

Government with a view to military operations in the time of war. Enumerating certain routes worthy of consideration he said: "If to these communications we add a road from Detroit to Ohio, which has already been commenced, and a canal from the Illinois river to Lake Michigan, which the growing population of the State of Illinois renders very important, all the facilities which would be essential to carry on military operations in the time of war, and the transportation of the munitions of war for the defense of the western portion of our northern frontier would be afforded."

Mr. Calhoun transmitted with his own report one made by Major Stephen H. Long, dated May 12, 1818, giving an account of a tour of exploration in the West the year previous. Major Long said a canal uniting the waters of the Illinois river with those of Lake Michigan might be considered the first in importance of any in this quarter of the country, the construction of which would be attended with very little expense compared with the magnitude of the object.

The first practical step toward the construction of a canal between Lake Michigan and the Illinois river was the execution of a treaty with the Indians by which a strip of land about twenty miles wide extending through the Desplaines and Illinois valleys from Chicago to Ottawa was ceded to the United States Government. This treaty was negotiated at St. Louis, August 24, 1816, by Ninian Edwards, governor of Illinois Territory, William Clark, governor of Missouri, and Colonel Auguste Chouteau of St. Louis. By this treaty the Indians ceded all the land "which lies south of a due west line from the southern extremity of Lake Michigan to the Mississippi river. And they moreover cede to the United States all the land contained within the following bounds, to-wit: beginning on the left bank of the Fox river of Illinois, ten miles above the mouth of the said Fox river; thence running so as to cross Sandy Creek, ten



miles above its mouth ; thence in a direct line to a point ten miles north of the west end of the Portage, between Chicago creek, which empties into Lake Michigan, and the river Depleines, a fork of the Illinois ; thence in a direct line to a point on Lake Michigan ten miles northward of the mouth of Chicago creek ; thence along the lake to a point ten miles southward of the mouth of the Chicago creek ; thence in a direct line to a point on the Kankakee ten miles above its mouth ; thence with the said Kankakee and the Illinois rivers to the mouth of Fox river and thence to the beginning."

For this land the Indians received "a considerable quantity of merchandise," and an agreement that they would receive annually for twelve years goods to the value of \$1,000. The grant contained 9,911,411 acres and included the present site of Chicago. Governor Edwards said afterward in a communication to the State Legislature that he personally knew that the Indians were induced to believe that the opening of a canal through these lands would be very advantageous to them, and that, under authorized expectations that a canal would be constructed, they ceded the land for a trifle. On this fact the governor based an argument for the early inception of the work, saying: "Good faith, therefore, towards these Indians, as well as the concurring interest of the State and of the Union, seems to require that the execution of this truly national object should not be unnecessarily delayed, and nothing is more reasonable than that the expense should be defrayed out of the proceeds of the very property which was so ceded for the express purpose of having it done."

Whatever the form and the extent of the agitation immediately following the execution of this treaty, it resulted in the introduction of a resolution by John Holmes of Massachusetts in the lower House of Congress on December 11,

1817, instructing the committee on so much of the President's message as related to roads and canals to inquire into the expediency of providing by law for constructing a navigable canal to unite the waters of Lake Michigan with the Mississippi. The resolution was carried, but the committee made no report.

In the House on April 3, 1818, when the question of the admission of the Territory of Illinois to statehood was under discussion Mr. Pope of Kentucky offered an amendment which carried the boundary further north. The object, he said, was to gain for the proposed State a coast on Lake Michigan. This would afford additional security to the perpetuity of the Union, inasmuch as the State would thereby be connected with the States of Indiana, Ohio, Pennsylvania and New York through the lakes. The facility of opening a canal between Lake Michigan and the Illinois river was acknowledged by every one who had visited the place. Giving to the proposed State the port of Chicago, embraced in the proposed limits, would draw its attention to the opening of the communication between the Illinois river and that place and the improvement of that harbor. The amendment was agreed to and Illinois gained both Chicago and the Illinois and Michigan canal.

Illinois became a state in 1818. Daniel P. Cook, a son-in-law of Governor Edwards, was its second representative in Congress, serving from 1819 to 1827. He devoted himself assiduously to the interests of the proposed canal. Through his influence the Illinois State Legislature of 1820-1 had a partial survey of the route made, sufficient to demonstrate the practicability of the undertaking. A report of this survey was laid before Congress by Mr. Cook on December 7, 1821, with this resolution: "That the committee on public lands be instructed to inquire whether any, and, if any, what provision is necessary to be made to

enable the State of Illinois to open a canal through the public lands to connect the waters of Lake Michigan with the Illinois river."

As an illustration of the opposition to the implied coöperation of the United States it may be noted that John Floyd of Virginia thought that Congress had already sufficiently evinced its liberality to the new States. On a former occasion he had proposed a resolution to appropriate a portion of the public lands for the endowment of colleges. That resolution had received the decided opposition of the new States. A constitutional question was raised on the subject, which, if it did not convince, at least it created so much doubt in his own mind as to induce him to forbear to press it. Nor could he, in the present instance, as a member of a State which had done as much at least as any State in the Union for the general benefit, consent to a proposition of this sort. As well might Virginia ask for an appropriation of the public funds for the purpose of completing canals to the city of Richmond. He was disposed to leave the subject of canals to the energy and ability of those States through which they passed and for whose benefit they were intended.

Mr. Cook replied that he did not expect a proposition so reasonable as he conceived this to be would meet with opposition. The States northwest of the Ohio felt grateful for all the favors they had received, but in the present case no favor was asked. The object of the resolution was not to solicit a donation from the General Government to assist in making the canal, but merely to reserve a narrow strip of land in the direction of the contemplated canal and through which it should pass. By this measure the Government instead of impairing its funds, would increase them. Such an act would undoubtedly enable the Government to dispose of the reservation afterward at a price greatly enhanced and at the same time virtually authorize the government of Illinois

to go on with its contemplated undertaking. The resolution was adopted.

A few days later the matter was brought to the attention of the Senate by Jessie B. Thomas of Illinois, who presented on December 19, 1821, a resolution adopted by the Illinois State Legislature praying to be authorized to construct a canal connecting the waters of Lake Michigan with the Illinois river, and asking for the donation of a certain quantity of land for that purpose. This was referred to the committee on roads and canals.

Resolutions and debates at last begun to bear fruit, although of doubtful quality. In the House on January 14, 1822, Christopher Rankin of Missouri, for the committee on public lands to whom the matter had been referred, reported a bill authorizing the State of Illinois to open a canal through the public lands, and a similar bill was introduced in the Senate on January 24, 1822, by Mr. Thomas. Having passed both Houses, it became a law on March 30, 1822. The Act reserved ninety feet of land on each side of the canal from any sale to be made by the United States. "The use thereof forever," said the bill, "shall be, and the same is hereby, vested in the said State for a canal, and for no other purpose whatever; on condition, however, that, if said State does not survey and direct by law said canal to be opened, and return a complete map thereof to the treasury department, within three years from and after the passage of this Act; or, if the said canal be not completed, suitable for navigation, within twelve years thereafter; or, if said ground shall ever cease to be occupied by, and used for, a canal suitable for navigation, the reservation and grant hereby made shall be void and of none effect."

Congress took care that this meager grant should not carry with it any liabilities. It was provided that nothing in the Act should be construed to imply any obligation on the part of the United States to appropriate any money to

defray the expense of surveying or opening the canal ; also, "that the said canal, when completed, shall be, and forever remain, a public highway for the use of the Government of the United States, free from any toll or charge whatever, for any property of the United States, or any persons in their service, passing through the same."

Permission to construct a canal through the lands owned by the United States was in no sense an aid to the young and struggling State of Illinois. Its population at this time was less than 60,000, and the people were unable even to pay for the survey of the route of a canal. It had been repeatedly shown that the proposed work was, at that time, of greater National than State importance, and every public officer of the National Government who had given any attention to the canal had recommended its construction. Not only were the indirect advantages apparent, but it was acknowledged by all that there would be a direct financial gain to the Government, if it were to donate sufficient land to pay for the work, in the increased value of the unappropriated lands. Mr. Cook was not disposed to accept a questionable favor, and, on behalf of the State, he renewed his appeals in Congress for something like a reasonable recognition of the undertaking. On March 26, 1824, on his motion, the House committee on roads and canals was instructed to inquire into the expediency of vesting in the State of Illinois, for the purpose of defraying the expense of opening a canal between the waters of the Illinois river and Lake Michigan, the land bordering on the proposed canal that had been reserved from sale by Congress.

In the following year this committee reported in favor of the appropriation. Among other suggestions it urged that, in a political point of view, its importance would be found not less imposing than in either of those in which it had already been viewed. In uniting and drawing together the interests of the remote extremities of the eastern, the

southern and the western sections of the Union, no work of the same magnitude, it was believed, could be more effectual. The geographical position of Illinois and Missouri, the two States particularly interested in it, was such that they would, under the advantages of this communication, have a common and almost equal interest in preserving their connection with the North and the South. Their trade would ultimately flow through the lakes and the Mississippi, and the advantages of a choice of market would be so important to them that they must ever be unwilling to surrender it. By a reference to the map of the country, it would be seen that these States would have it in their power at all times, in the event, should it unfortunately ever occur, of any internal commotion, to command the waters of the Ohio and Mississippi. From their commanding position, therefore, as well as from their capacity to sustain a dense, and it must mainly be a free population, they would always hold the balance of power in deciding every effort that might be made to separate the West from either or both of the great geographical divisions of the Union; and, if from no other cause, their interests would direct their exertion of that power in favor of the Union. Nor was the interest of these States in preserving a free outlet for their commerce both through the lake and the Mississippi, the latter of which opened to them the New Orleans, the West Indies and South American markets, stronger than must be that of the North and South in being united with them.

The feeling among the people of Illinois was reflected in a letter written by ex-Governor Edwards to Henry Clay in 1825, just after the latter had been chosen secretary of state by John Quincy Adams. Mr. Edwards said: "A favorite object and, indeed, a political hobby that supersedes all others in this state and Missouri, is a canal to connect Lake Michigan and the Illinois river. Nothing could sustain the administration or its friends in these two States so effect-

ually as its countenancing this measure." The writer ventured to suggest that it might be very judicious in the President, without descending to any particular case, to introduce in his message to Congress some sentiment favorable to the connection of the great lakes with the Atlantic and western waters. He knew it would contribute greatly to the support of the administration.

In its anxiety to have the work on the canal begin the Illinois State Legislature, on January 17, 1825, incorporated the Illinois and Michigan Canal association and granted it extraordinary privileges. It was provided in the charter of the association that all cessions, grants and transfers made, or that might thereafter be made by the Government of the United States, for the purpose of promoting the construction of the canal, should be vested in that corporation. Congress is said not to have approved of the State's giving away valuable privileges in advance of their possession, and the Act nearly deprived the State of any future grant of lands. Mr. Cook was alarmed over the action and hastened to advise the State Legislature to repeal the Act. The incorporators finally surrendered their charter, but not until Mr. Cook had sent an address to the people of the State, setting before them the interest which the National Government had in the undertaking.

"This is a work," he said, "in which the nation is interested and which the General Government should, therefore, aid in executing. As a ligament to bind the Union together, no work of the same magnitude can be more useful. Occupying, as Illinois and Missouri do, a central position in the great semicircle of States on the north and west, and commanding, as they do, the commerce of the three great rivers of the West, the Ohio, Mississippi and Missouri, they may well be called the keystone of the widely projected arch. From New York to Louisiana, following the frontier curve of that portion of the Union, in the event of any political

commotion or attempt at separation, the influence of these States would, ere long, be sensibly felt, and would even decide the contest. And their interest will be so happily balanced, by their desire for a free outlet through both the Mississippi and the lakes, that so long as commercial advantage continues to influence the policy of the States, they must and will decide against disunion. The friends of the Union, therefore, have a strong interest in this communication."

Having undone an injudicious act of the people at home Mr. Cook redoubled his efforts in impressing upon Congress its duty in the matter of extending substantial aid to the canal. On December 30, 1824, he moved a resolution in the House providing that a committee be appointed to inquire whether any, and, if any, what provision it would be proper or practicable to make to aid the State of Illinois in opening a canal. By way of explanation he said it was not likely the State, from its ordinary means, could carry the measure already passed by Congress into effect. Congress had given to the State of Illinois a certain proportion of the net proceeds of the sales of the public lands for the encouragement of learning. If no better means should present themselves, and if the Government of the United States should not consider the canal, in a national view, of so much importance as to construct it at its own cost, the State might be allowed to convert its school lands into a fund for the purpose of making the canal, and to apply the tolls from the canal to school purposes, thus merely changing the land into a canal stock, the profits of which to be applied to the same purpose the land was to serve, that of encouraging learning. The canal was really a national object, worthy of the employment of the national means.

After a number of discouraging postponements, Mr. Cook succeeded in getting his resolution before a committee, and in the following year a bill was reported. This was the

basis for the Act under which the Illinois and Michigan canal was constructed. The bill was repeatedly postponed, lost and reconsidered, and there were many acrimonious debates. One member went into a calculation to show that the proposed grant of lands would not only defray all the expenses of the canal, but would leave a balance in the Illinois treasury of \$500,000 to \$1,000,000. Another denied that Illinois had any better right to a portion of the public lands than Virginia or any other State. The lands, when ceded, were to be set apart to pay the public debts, but Congress appeared to have forgotten that stipulation, and the lands, it seemed, were to be given to any person who lived nearest to them. Would it not be best, he asked, to sell the whole at once and divide the proceeds?

Charles Miner of Pennsylvania, wanted the bill recommitted with instructions to the committee to inquire into the expediency of subscribing on behalf of the United States for stock in the proposed canal, to an amount not exceeding one-third of the whole, the stock to be paid for out of the proceeds of lands on or near the route. He avowed his decided hostility to the bill. What did it propose? To give to the State of Illinois alternate sections of land along the whole line of the proposed canal from Lake Michigan to the Illinois river. What was the extent of this grant? It was estimated at about 200,000 acres; but, as the extent of the line of the canal was indefinite, so the grant was indefinite. Illinois might make the canal only fifty or sixty miles long and demand 200,000 acres; but she might extend the canal down the Illinois along the whole extent of the State, and, under the bill, demand 500,000, 800,000 or 1,000,000 acres. Such uncertain, indefinite grants were extremely objectionable.

"On the line of the canal," said Mr. Miner, "villages, towns and cities will grow up. Some of the tracts will be of great value. Take them all together, it will not be an

unfair estimate to put them at \$5 an acre. Suppose the canal sixty miles in length and the land given 200,000 acres. You give then \$1,000,000 to Illinois. The canal is estimated to cost from \$600,000 to \$800,000, so that you make the canal and give a bounty to that State besides. Who makes the canal? Those who furnish the funds. The people of the United States make the canal, and then they are to be taxed to all enduring time for liberty to use it. This seems to me a wild waste of the public domain. I entreat you, gentlemen, to pause before you make this excessive grant. In my opinion it will bring a system of internal improvements more into disrepute than all the arguments of its enemies. Pennsylvania came this session, I will not say cap in hand and with bended knee, but in the most respectful manner, and asked the grant of one little township for her institution for the deaf mutes,—poor dumb mouths; they could not plead for themselves. What was the answer? This petition was rejected,—this request was refused. And now you propose to give to Illinois 200,000 acres. I hope the bill may be recommitted."

The bill was not recommitted, nor was it otherwise delayed. It passed both the House and the Senate on March 2, 1827, the day on which Mr. Miner made his vigorous opposing speech, and was at once approved by the Executive. Much credit is due Mr. Cook for his persistent and eloquent advocacy of the bill. Through his influence the Legislature of Illinois was called together in special session in January, 1826, and the following memorial to Congress was adopted:

"The memorial of the General Assembly of the State of Illinois respectfully represents: That the construction of a canal, uniting the waters of Lake Michigan with the Illinois river, will form an important addition to the great connecting links in the chain of internal navigation, which will effectually secure the indissoluble union of the confederate members of this great and powerful Republic. By the

completion of this great and valuable work, the connection between the North and South, the East and the West, would be strengthened by the ties of commercial intercourse and social neighborhood, and the union of the States bid defiance to internal commotion, sectional jealousy and foreign invasion. All the States of the Union would then feel the most powerful motives to resist every attempt at dissolution. To effect so great and desirable an object your memorialists believe to be of sufficient importance to engage the attention and awaken the munificent patronage of a Government whose principle of action is the promotion of the general welfare. Your memorialists are sensibly alive to the spirit of improvement that manifests itself in almost every section of our extensive country, and would fain lend a helping hand in so great and good a cause; their situation, however, forbids their doing much, without the aid of the Federal Government, into whose treasury almost all the funds, whether brought hither by immigrants, or earned by the industry of their citizens, are paid for the purchase of the public lands. While this state of things shall continue, and the money thus paid into the treasury of the Union is taken out of our State, our people will not be able to engage in the glorious work of improving our common country.

“Ought the people of this State stand by, with folded arms, and behold the great work of internal improvement progress in other States, without making an effort to improve their own condition, and at the same time advance the interest of our beloved country? A condition thus paralyzed is at war, not only with our interests, but with the best feelings of our hearts. Did this State possess the public domain lying within its bounds, as is the case with older members of this confederacy, your memorialists would not appear before your honorable body to solicit aid in this important work. If, as your memorialists believe, the con-

struction of the canal would be highly beneficial to the Union at large; if the receipts into the treasury of the United States would be augmented by the increased sales of the public lands, and if the interests of the State would be also advanced thereby, is it unreasonable to apply to a paternal government for assistance in the promotion of such beneficial ends? It is unnecessary for your memorialists to enlarge on the great advantages of this canal to the Union, in the facilities to be afforded in the event of a war either with the Indian tribes inhabiting our frontier, or the British Nation. Your honorable body is aware that this State is situated on the borders of an Indian country, filled with numerous and powerful tribes of the sons of the forest. If our country should be again engaged in war, the saving of expense in the transportation of the munitions of war would alone defray the expense of the contemplated canal, and justify the United States in making a liberal appropriation for its construction.

“Your memorialists do not, however, ask your honorable body to appropriate money out of the treasury to aid them in this work. They only ask for a tract of land, through which the contemplated canal may pass, and which for a series of years will be wholly unproductive to the Government, unless the canal shall be commenced under auspices favorable to its construction, in which event all the land in its vicinity would immediately become available to the United States. Your memorialists sincerely believe that a liberal appropriation of land for this object would, even in a pecuniary point of view, be of immense importance to the treasury of the Union. The public lands in the vicinity would not only sell, but at a considerable advance of the minimum price. Should this opinion be correct (and does not experience justify it?) the United States would be gainer by the proposed donation to the State.

“Your memorialists further state that, at their last ses-

sion, they passed an act of incorporation, upon very liberal terms, authorizing a company to construct the projected canal; but the remoteness of the country from the residence of capitalists has prevented them from engaging in the work. At their present session, your memorialists have repealed the charter, and their only hope of soon beginning the work depends upon the liberality of your honorable body. Your memorialists have caused the route to be explored and estimates to be made of the probable expense of the work, from which it appears that the cost of constructing the canal will not be less than \$600,000, and may possibly amount to \$700,000.

“To the end, therefore, that your memorialists may be enabled to commence and complete this great work, we pray your honorable body to grant to this State the respective townships of land through which the contemplated canal may pass, the avails of which to be appropriated exclusively to the construction of said canal, upon such terms and conditions as to your honorable body may seem proper.”

The bill which this memorial must have aided greatly in passing enacted “that there be and hereby is granted to the State of Illinois, for the purpose of aiding the State in opening a canal to unite the waters of Illinois river with those of Lake Michigan, a quantity of land equal to one-half of five sections in width, on each side of said canal, and reserving each alternate section to the United States, to be selected by the commissioner of the land office, under the direction of the President of the United States, from one end of the said canal to the other; and the said lands shall be subject to the disposal of the Legislature of the said State, for the purpose aforesaid, and no other: Provided, That the said canal, when completed, shall be and forever remain a public highway for the use of the government of the United States, or persons in their service passing through the same:

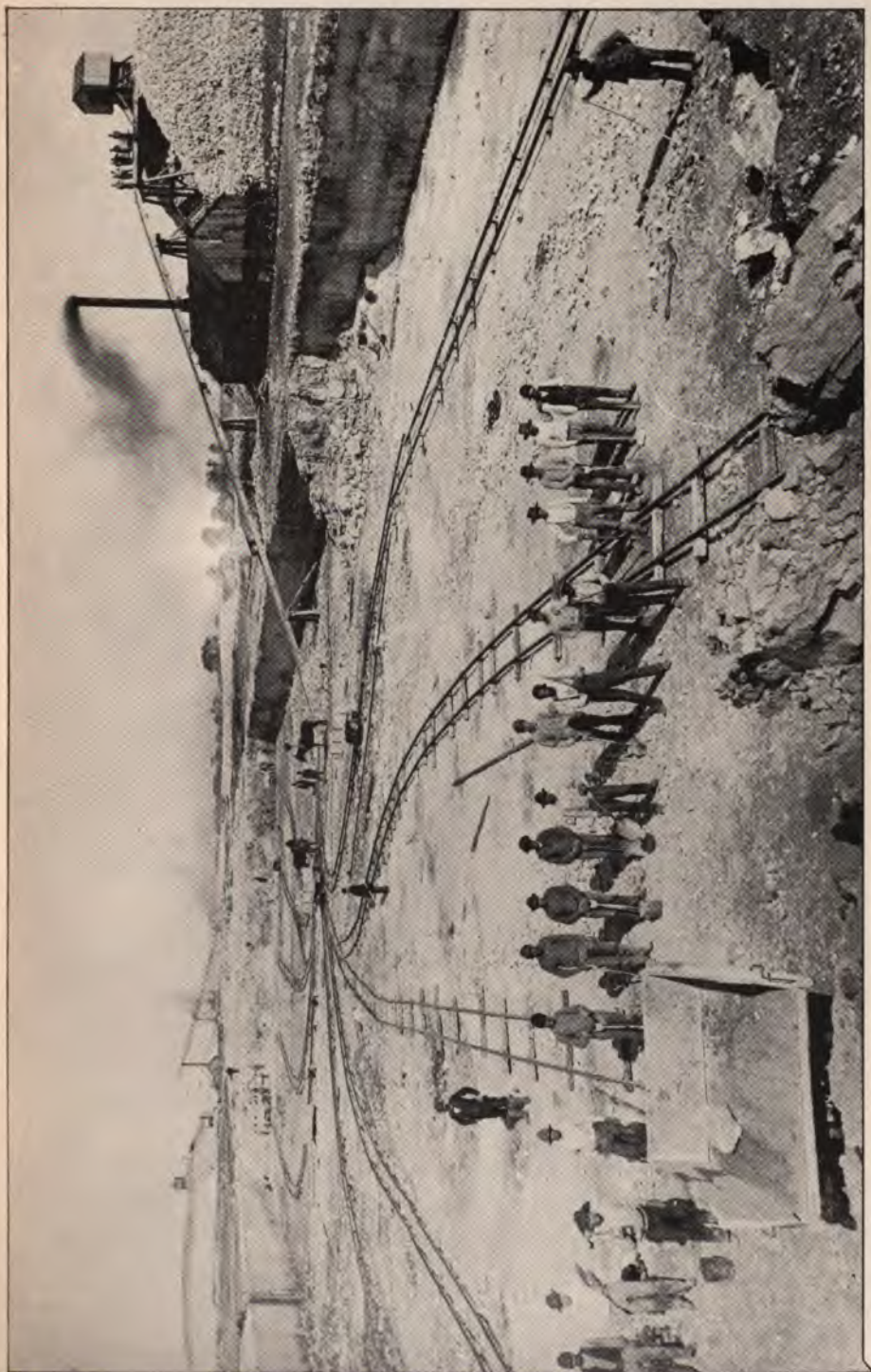
Provided, That said canal shall be commenced within five years, and completed in twenty years, or the State shall be bound to pay to the United States the amount of any lands previously sold, and that the title to purchasers under the State shall be valid."

It was enacted, in the second section of the bill, that, so soon as the route of the canal was agreed upon, it should be the duty of the governor, or such person, or persons, as might be authorized to superintend the construction of the canal, to examine and ascertain the particular sections to which the State should be entitled. By the third section the State was empowered to sell the whole or any part of the land.

Before the State was ready to begin work on the canal, the superior advantages of railroads were making a strong impression upon the minds of the people. The most extravagant schemes for the improvement of the means of intercommunication were projected, and ultimately brought the State to the verge of financial ruin. It was urged that a railroad be substituted for the canal, and the National Legislature was asked to make the necessary amendment to the Act of 1827. Such an amendment was passed and approved on March 2, 1833. The time for commencing and completing the canal, or railroad, whichever the State might choose to make, was extended five years. The Government reserved the same rights and privileges in the use of the railroad as in that of the canal.

These three Acts include all the national legislation in the interest of the Illinois and Michigan canal. It was tardy and parsimonious treatment of a great public enterprise, a work of greater national than local importance. But the legislation by the General Government made possible an improvement which the State could not have undertaken alone. When the construction of the canal was finally assured, western immigration received a new impetus.

The population of Illinois was nearly doubled in the five years from 1835 to 1840. While the canal has been of inestimable value to the State, it has also been an important factor in the development of the entire West and North-west.



AND FIRST LOT OF FREIGHT CARS, WITH A LOCOMOTIVE, IN 1867. THE WHOLE AND ONE THIRD, DEPOSITED, BEING

CHAPTER XI.

WATERWAY LEGISLATION BY THE STATE.

At the first session of the Illinois Legislature following the Act of Congress authorizing the state to open a canal through the public lands, the conditions of that Act were accepted and steps taken to proceed with the work. No less than forty Acts and two joint resolutions relating to the canal and the improvement of the Illinois river have been passed by the State Legislature since.

Little progress was made during the first ten years. Commissioners were appointed to examine the route of the proposed canal, but the State found it difficult even to pay their expenses. The undertaking was abandoned in 1833, nothing having been accomplished except to make some imperfect surveys. The construction of railroads in the West had just begun and the people came to the conclusion hastily that canal transportation would be wholly superseded by the new methods. They soon found that railroads could not be built for nothing and that canals had many advantages. In 1836 a new canal Act was passed and work under it was at once inaugurated. Since that date the Illinois and Michigan canal has been the subject of excessive State Legislation. Its history can be traced through the more important enactments, an abstract of which is here given, the date preceding each Act being that of its approval :

FEBRUARY 14, 1823. Act to Provide for the Improvement of the Internal Navigation of the State.

Emanuel J. West, Erastus Brown, Theophilus W. Smith

Thomas Sloo, Jr., and Samuel Alexander are appointed a Board of Commissioners to adopt such measures as may be requisite to effect a communication, by canal and locks, between the navigable waters of the Illinois river and Lake Michigan.

The Commissioners shall require an examination of the probable route of the canal to be made, cause the necessary surveys and levels to be taken, and maps, field books and drafts to be made, and adopt plans for the construction of the canal. They shall make an estimate of the expense of constructing the canal and report all their proceedings to the next General Assembly.

The Commissioners shall recommend to the Governors of Ohio and Indiana and the Legislatures of those States the importance of connecting the waters of the Wabash and Maumee rivers by canal communication.

The sum of \$6,000 is appropriated to pay the expenses of the Commission.

JANUARY 22, 1829. Act to Provide for Constructing the Illinois and Michigan Canal.

The Governor shall appoint biennially three Commissioners who shall adopt such measures as may be required to effect the communication, by means of a canal and locks, between the Illinois river and Lake Michigan. The Commissioners shall cause surveys to be made to determine the most eligible route, and as soon as they may be able to command sufficient funds shall commence the work of construction.

The Canal Commissioners shall select, as soon as practicable, in conjunction with such Commissioners as shall be appointed by the Commissioner of the General Land Office, under the direction of the President of the United States, the alternate sections of land granted by Act of Congress. As soon as the lands shall have been selected the Commis-

sioners shall proceed to sell the lands at any place, either in this State or elsewhere.

The canal shall have the following dimensions : At least 40 feet in width at the Summit water line, 28 feet at the bottom, and of sufficient depth to contain at least four feet of water. It shall be furnished with locks, aqueducts and dams required by boats at least 75 feet long, 13 feet and six inches wide, and drawing three feet of water.

FEBRUARY 15, 1831. Act to amend the Act of January 22, 1829.

The concurrence of the Senate is required in the appointment of the Canal Commissioners.

The Governor shall appoint one of the Commissioners of the Board Acting Commissioner, who shall be constantly employed on the canal route. He shall fix the prices and let the contracts for the excavation and construction of the canal.

The Commissioners are authorized to sell lands in tracts of forty acres, and may subdivide other tracts into smaller lots and sell them as they may think most profitable to the canal fund.

The Commissioners may employ an engineer, without regard to any that has been promised on the part of the General Government, to survey the line of the canal, and for all other purposes connected with it. They may cause the engineer to examine the Illinois river from the mouth of the Fox river down to the head of the steamboat navigation. If, in their opinion, the navigation of the Illinois river can be improved by dams and locks, or otherwise, so as to secure its navigation as far upward as the mouth of the Fox river, with as little expense and as much utility as canalizing from Fox river to the Little Vermilion, or foot of the rapids, they may terminate the canal at the mouth of the Fox river.

The Commissioners may so improve the mouth of Fox river, if they deem it proper to terminate the canal there, as to open a channel under the bluff of the town of Ottawa of sufficient depth for steamboat navigation. All the ground between the bluff and the Illinois river in the town of Ottawa shall be reserved from sale.

The Commissioners are authorized to give a quantity of lots, not exceeding ten acres, to aid in the erection of public buildings in any town laid off on the canal lands that has become the seat of justice.

The superintending commissioner and the engineer are empowered to fix the dimensions of the canal.

The engineer employed by the superintending commissioner shall ascertain whether the Calumet will be a sufficient feeder for the part of the canal between the Chicago and Desplaines rivers, "or whether the construction of a railroad is not preferable, or will be of more public utility than a canal." If the Commissioners shall be satisfied of the sufficiency of the river, and that a canal will be of more public utility than a railroad, it shall be their duty to commence the excavation without delay. If they should be of the opinion that it would not, all further proceedings in relation to the canal shall be deferred until the next meeting of the Legislature: Provided, the Commissioners shall cause such commencement to be made in the progress of the canal as to bring the State within the act of Congress making such grant so as to save the grant to the State.

MARCH 1, 1833. Act to Abolish the Office of Canal Commissioners.

The office of Canal Commissioners, created by the acts approved January 22, 1829, and February 15, 1831, is abolished.

The Canal Commissioners shall deliver all moneys, books, etc., in their possession to the treasurer of the State and the auditor of public accounts.

The treasurer of the Board shall deliver to the treasurer of the State all moneys in his hands belonging to the canal fund, and shall deliver to the auditor of public accounts all books, papers, etc.

The auditor, attorney general and treasurer of the State shall adjust the affairs of the Canal Commissioners and their treasurer and report a detailed statement of their proceedings to the next General Assembly of the State.

JANUARY 9, 1836. Act for the Construction of the Illinois and Michigan Canal.

The Governor of the State is authorized to negotiate a loan on the credit and faith of the State to aid in the construction of the Illinois and Michigan Canal for a sum not exceeding \$500,000.

Certificates of stock for the loan, to be called the Illinois and Michigan Canal stock, bearing interest not exceeding 6 per cent, payable semi-annually, at the bank of the State of Illinois or any of its branches, or at some bank in the cities of New York, Philadelphia or Boston, and reimbursable at the pleasure of the State at any time after the year 1860, shall be issued, for the payment of which the faith of the State is irrevocably pledged. The stock shall not be sold for less than its par value.

The Governor, with the concurrence of the Senate, shall appoint three citizens of the State to constitute a Board to be known as the Board of Commissioners of the Illinois and Michigan Canal. After the first Monday in January, 1837, they shall be chosen biennially in such manner as the Legislature may direct. One of the Commissioners shall be acting commissioner and receive \$1,200 per annum.

The acting commissioner shall make all contracts for the supply of material and performance of labor, have the immediate care and superintendence of the canal, and perform the duties of an executive officer.

The canal shall be not less than 45 feet wide at the surface, 30 feet at the bottom, and of sufficient depth to insure a navigation of at least four feet. It shall be supplied with water from Lake Michigan and such other sources as the Canal Commissioners may think proper. Ninety feet shall be reserved on each side of the canal to enlarge its capacity whenever, in the opinion of the Board, the public good shall require it. This ground may be leased until needed.

Means shall be taken for the immediate construction of the canal. The Commissioners may enter upon and use any lands, water, streams and materials of any description necessary for the prosecution of the works contemplated by this Act.

The Commissioners shall select such places on the canal route as may be eligible for town sites and cause them to be laid off into town lots, including the canal lands in or near Chicago.

The revenue arising from the canal and from the sale of the lands granted, or that may hereafter be granted to the State by Congress for the construction of the canal, and the net tolls, are pledged for the payment of the interest accruing on the stock, and for the reimbursement of the principal.

The canal shall commence at or near the town of Chicago and terminate near the mouth of the Little Vermillion in La Salle county.

MARCH 2, 1837. Act to Amend the Act Approved January 9, 1836.

At the present session of the Legislature three citizens shall be appointed to constitute the Board of Canal Commissioners, one of whom shall be president, one treasurer and one acting commissioner.

The Commissioners shall proceed immediately to the final prosecution and completion of the canal upon the plans set out upon by the Commissioners in the year 1836. They

shall require a survey of the route as now established by an engineer whose report shall be transmitted to the next session of the General Assembly. The examination shall be made with a view of ascertaining whether there is sufficient water within the legitimate authority of the State to supply a canal of the size of the one now contemplated.

As soon as convenient the Board shall authorize a survey and estimate to be made of the route of a canal diverging from the main trunk of the Illinois and Michigan canal through the Aug-sau-ge-nash-ke swamp and lake, to intersect the Calumet river at the nearest practicable point, the work to be constructed whenever the State of Indiana shall undertake a similar work, connecting her system of internal improvements with the Illinois and Michigan canal.

The Commissioners shall have power to sell such parts of the canal lands in the township in which Chicago is situated, and such alternate lots in such town sites at the termination of and along the canal route as may be laid out by them, as may be necessary to produce the sum of \$1,000,000.

The Commissioners shall construct a navigable feeder from the most practicable point on Fox river to the Illinois and Michigan canal at the town of Ottawa.

The Governor is authorized to borrow \$500,000 on the same terms and in the same manner as prescribed in the Act to which this is an amendment, which sum shall be expended on the canal in the year 1838, in addition to the moneys arising from the sale of the canal lands and which may then be in the treasury of the Board.

The Commissioners shall retain in their hands, during the progress of the work, at least 15 per cent and not more than 30 per cent of the value of the work performed until the full completion of the contracts.

JULY 21, 1837. Act to Provide for the Sale of Certain Lands, and for other Purposes.

The Commissioners of the Illinois and Michigan canal are authorized to select lots or tracts of land along the line and subdivide them into lots of not less than forty, nor more than eighty acres, no lot to lie within less than one-half mile of the canal, and the quantity not to exceed in value \$400,000, one-tenth of the purchase money to be paid at the time of sale and the balance payable in ten equal annual installments, bearing an interest of 6 per cent.

The navigable feeder at Ottawa may be so altered as to connect with the Fox river instead of the Illinois river.

The Commissioners are authorized to enlarge the natural basin at the confluence of the North and South branches of the Chicago river. Block No. 7 of canal lots in the city of Chicago shall be reserved from sale for the purpose of exchanging it for block No. 14, which will be required in the enlargement of the basin.

If the funds provided by existing laws prove insufficient to meet the expenditures upon the canal for the years 1837 and 1838, the Governor is authorized to negotiate a loan not exceeding \$300,000.

FEBRUARY 26, 1839. Act to Amend the Several Laws in Relation to the Illinois and Michigan Canal.

Sales of lots may continue until they amount to \$400,000.

When contracts have been forfeited or abandoned, the Commissioners may make new contracts without advertising for proposals, provided the price does not exceed the estimates of the engineer.

The Canal Commissioners shall proceed to the construction of the canal diverging from the main trunk of the Illinois and Michigan canal through the Saganaskee swamp whenever they shall be notified that the state of Indiana has commenced the construction of a corresponding work to connect her system of internal improvements with the Illinois

and Michigan canal. This canal shall be considered a part of the Illinois and Michigan canal.

If the Board shall be satisfied that any section of the work can be executed at less cost to the State by the employment of laborers than by contract, they are authorized to adopt that plan.

FEBRUARY 1, 1840. Act to Amend the Several Laws in Relation to the Illinois and Michigan canal.

There shall be one principal engineer whose salary shall be \$2,000 per annum, one resident engineer at a salary of \$1,500, and seven assistant engineers at a salary each of \$1,000.

Should there be no funds on hand to meet the liabilities of the State to the contractor, at the estimate to be made on the first of March next, checks shall be issued bearing 6 per cent interest.

FEBRUARY 21, 1843. Act to Provide for the Completion of the Illinois and Michigan Canal and for the Payment of the Canal Debt.

The Governor of the State is authorized to negotiate a loan solely on the credit and pledge of the canal, its tolls, revenues and lands, to be granted to Trustees, of \$1,600,000, for a term not exceeding six years, and at a rate not exceeding 6 per cent, payable out of the first moneys to be realized from the canal, its lands, tolls and revenue.

The holders of canal bonds and other evidences of indebtedness of the State in aid of the canal, shall be first entitled to subscribe to the new bonds.

After the loan shall have been subscribed, there shall be appointed three discreet persons to constitute a Board to be known as the Board of Trustees of the Illinois and Michigan canal. One of the Trustees shall be appointed by the Governor, and the other two elected or appointed by the sub-

scribers to the loan. The first Trustees shall be elected at Lockport, and hold office for two years. Subsequent elections shall be held every two years.

The Trustees shall possess all the powers and perform all the duties conferred upon the Commissioners.

To secure the payment of the loan, the State irrevocably grants to the Board of Trustees the bed of the canal and the land over which it passes, including its banks, margins, tow-paths, feeders, basins, right of way, locks, dams, water power, structures, stone excavated, and the stone material quarried, purchased, procured or collected for its construction; all the property, right, title and interest of the State of, in and to the canal, with all the hereditaments and appurtenances belonging to it, and all the remaining lands and lots belonging to the canal fund, or which may hereafter be given, granted or donated by the General Government to the State to aid in the construction of the canal, the Board of Trustees to have, hold, possess and enjoy the same as fully and as absolutely in all respects as the State now can or hereafter could do for the uses, purposes and trusts hereinafter mentioned.

When appointed, the Trustees are authorized to take possession of the canal and its property and proceed to complete the canal. They are authorized to make such changes in the original plan of the canal as they may deem advisable, without reducing its present capacity, or materially changing its present location, having due regard to economy, permanency of the work and an adequate supply of water at all seasons. None of the lots, lands or water powers granted to the Trustees shall be sold until three months after the completion of the canal.

The Trustees shall proceed to the completion of the canal in a good, substantial and workmanlike manner, so that, if practicable, it shall be ready for use and navigation within two years and six months from the time this Act goes into

operation, and they shall make annual reports to the Governor.

The Board shall establish annually a tariff of tolls, the Legislature reserving the right to increase the tolls. When completed, the canal shall, in all future time, be free for the transportation of the troops of the United States and their munitions of war.

After the completion of the canal, annual dividends shall be paid, first to holders of certificates, second to subscribers to the loan who are holders of bonds, third to non-subscribing holders of bonds in payment of interest, and fourth to the principal of the bonds. Upon the payment of all debts the canal shall revert to the State.

Three persons shall be appointed by the Governor to appraise the damage sustained by the contractors in being deprived of the canal. Certificates in payment of the canal indebtedness, bearing 6 per cent interest, shall be issued, the holders of the certificates to be entitled to all privileges conferred upon the other holders of canal indebtedness.

Bondholders and others failing to subscribe for the loan, the Governor is authorized to effect a contract to meet the requirements of the Act.

MARCH 1, 1845. Act Supplemental to the Act of February 21, 1843.

The Governor shall execute a deed of trust to the Trustees after the contract for the loan of \$1,600,000 has been executed.

The election for Trustees may be held in the city of New York.

If the canal shall not be completed in three years the subscribers shall not forfeit the priority of payment secured to them.

FEBRUARY 14, 1857. Act to Incorporate the Illinois River Improvement Company.

William F. Thornton, William B. Ogden, George Steele, George Barrett, John B. Preston and forty others are made a corporation under the name of the Illinois River Improvement company, and there is granted to this corporation the right of raising and maintaining in the Illinois river by means of a system of dams and locks a body of water of such height as to admit the convenient passage of steamboats of ordinary draft between the steamboat basin at LaSalle and the Mississippi river, having in all places between these points a depth of water not less than six feet. The dams shall not be raised so as to overflow the lands adjacent to the river to a greater extent than may be necessary to secure a depth of six feet of water in the channel at all times.

The capital stock of the company shall be \$3,000,000 and the par value of each of the shares \$100.

When \$50,000 shall have been subscribed, a meeting may be held and thirteen directors elected. The directors shall not begin the construction of locks or dams until *bona fide* subscriptions are made to the amount of \$1,000,000 and \$100,000 is paid in. Work shall be effectually commenced within two years and be completed within seven years.

The plans must be approved by a board composed of the Governor, auditor, treasurer, Stephen A. Douglas, William F. Thornton, William H. Swift, William Gooding, William B. Ogden and twenty others. A lock not less than 350 feet long and 75 feet wide must be constructed in each dam.

The company shall have power to lease all water power and collect rents and reasonable tolls. The net revenue above 15 per cent and 10 per cent interest added to the cost of the work shall be paid to the towns, cities and counties holding stock for the use of the public schools. Counties, cities and towns upon the Illinois river are authorized to become

stockholders in the corporation by a vote of the inhabitants by issuing bonds bearing interest not exceeding 10 per cent, but no bonds shall be issued until \$1,000,000 shall have been subscribed to the capital stock of the company by others and \$100,000 paid in.

The Illinois River Improvement company is authorized to borrow money to supply the means for the construction of the work and to issue bonds for a loan in sums of not less than \$500 and bearing interest not exceeding 8 per cent.

The corporation must not engage in commerce or a commission business.

FEBRUARY 22, 1861. Act Establishing Police Power.

The Board of Trustees of the Illinois and Michigan canal shall have all the power in regard to police regulations and making rules and regulations for the convenience of business over that part of the South branch of the Chicago river within 1,000 feet of the lock at Bridgeport which it has over the canal proper; also the same power over the canal basin at the termination of the canal on the Illinois river.

FEBRUARY 16, 1865. Act to Provide for the Completion of the Illinois and Michigan canal upon the Plan adopted by the State in 1836.

(This Act is given in abstract on page 73 in the chapter entitled "Efforts to Purify the Chicago River," upon which subject it has an important bearing.)

FEBRUARY 28, 1867. Act for Canal and River Improvements.

To secure the improvement and extension of the Illinois and Michigan canal through the valleys of the Bureau and Green rivers to the Mississippi at or above Rock Island

with a navigable feeder to Rock river at Dixon and Sterling, and to secure the improvement of the navigation of the Illinois, Rock and other rivers, the Governor is authorized, with the consent of the Senate, to appoint seven persons as Canal Commissioners, for a term of six years.

The Commissioners are authorized to make such changes in the location of the present canal, or adopt a river improvement instead of the canal between Chicago and La Salle as may be deemed expedient.

The Commissioners may commence the construction of a dam with lock on the Illinois river between La Salle and Peoria, not less than 350 feet long and 75 feet wide.

The outstanding bonds of the State, now a lien upon the franchises and revenues of the Illinois and Michigan canal, may be refunded or replaced by new bonds of a similar character, the interest not to exceed 6 per cent, and not for a longer term than twenty years.

If the owners or holders of such bonds shall assent to such refunding of the canal bonds, or a majority make such an exchange, it shall be lawful for the Board to take possession of the Illinois and Michigan canal and manage it as heretofore by the Canal Trustees, so far as the same may be practicable, in its enlargement into a ship or steamboat canal.

There shall be appointed by the Governor two persons, who, together with the Governor, shall constitute a committee to present a memorial to the Congress of the United States and urge the necessity of an immediate and liberal appropriation in aid of these improvements, such Commission to use its best endeavors to secure an appropriation of at least \$7,000,000 in aid of the improvements herein named.

If the United States appropriate one-half of the estimated cost of the improvements, then the Canal Commissioners may proceed with the work.

To carry on the improvements an annual tax of one mill on the dollar on all real and personal property is authorized until the improvement is completed. The first of the improvements to be begun and completed shall be the improvement of the Illinois river from La Salle to the mouth of the river.

The Board of Public Works of Chicago shall annually report to the Board of Canal Commissioners hereby created all the facts concerning the canal improvements under their charge.

Water power created in the construction of any of the improvements shall not be sold, but leased at 6 per cent of the valuation by the Commissioners, the valuation to be renewed every ten years, no lease to run longer than one hundred years.

FEBRUARY 29, 1869. Act to Amend the Act of February 28, 1867.

The number of the Commissioners is reduced to three and the term of service to two years. The appropriation is limited to \$400,000. The Commissioners are restricted to the surveys contemplated and to the construction of four locks and one dam in the Illinois river, and to the dredging out of the mouth of the canal at La Salle between the lower lock and the river.

The Commissioners are forbidden to commence the construction of the lock and dam, or the improvement of the Illinois river, unless they first ascertain from the estimates of at least two competent engineers, separately made, that the work can be completed for a less sum than \$400,000.

The Commissioners shall not take possession of, nor in any manner interfere with, the Illinois and Michigan canal, or its tolls or revenues.

APRIL 22, 1871. Act to Settle up and Close the Trust of the Board of Trustees of the Illinois and Michigan Canal.

The Canal Commissioners shall take charge of and exercise full control over the Illinois and Michigan canal from and after the passage of this Act.

MARCH 7, 1872. Act for the Control of the Canal and other Improvements.

The Board of Commissioners shall have the general control and management of the Illinois and Michigan canal, the lock and dam in the Illinois river at Henry, and of the Little Wabash river improvement.

APRIL 4, 1872. Act to Grant the Use of the Canals in this State to the Inhabitants of the Dominion of Canada.

When the Dominion of Canada shall have secured to the citizens of the United States the use of the Welland, St. Lawrence and other canals in the Dominion on terms of equality, then the use of the Illinois and Michigan canal, and of all other canals that may be constructed by the State, connected with the navigation of the lakes or rivers traversed by or contiguous to the boundary line between the possessions of the high contracting parties, is hereby granted to the subjects of her Britannic majesty on terms of equality with the inhabitants of the United States.

The sum of \$2,955,340, with interest until paid, is appropriated to relieve the lien for \$2,500,000 and interest, expended by the city of Chicago in the completion of the Summit division of the Illinois and Michigan canal, provided that not less than one-fifth, nor to exceed one-third, be applied by the city in reconstructing bridges and public buildings and other structures destroyed by the fire, the remainder to be applied to the payment of the interest on the bonded debt of the city and the maintenance of the fire and police departments.

JULY 1, 1873. Act Authorizing a Dam and Lock at or near Copperas Creek.

There is appropriated the net proceeds of the revenue of the Illinois and Michigan canal and lock at Henry on the Illinois river, until the expiration of the first fiscal quarter after the adjournment of the next regular session of the General Assembly, to be expended by the Canal Commissioners for the construction of a lock and dam across the Illinois river, at or near Copperas Creek, the lock to be not less than 350 feet long and 75 feet wide.

The state treasurer is required to invest the net earnings of the canal in United States or other interest bearing bonds until the amount has reached \$100,000, to be designated the Illinois river improvement fund. When the commissioners shall have \$100,000, they may commence the work, provided the cost shall not be more than \$400,000.

MARCH 27, 1874. Act Authorizing Removal of a Dam across the Calumet River.

The Governor is authorized to direct the Canal Commissioners to remove the feeder dam across the Calumet river near Blue Island without delay.

MAY 11, 1877. Act Appropriating the Unexpended Balance of the Illinois River Improvement Fund, and \$54,453.18 out of the Treasury for the Completion of the Copperas Creek Dam and Lock.

MAY 21, 1879. Act Appropriating \$30,000 for Each of the Next Two Years to Keep the Illinois and Michigan Canal in a Navigable Condition.

MAY 27, 1881. Act Appropriating \$30,000 for Each of the Next Two Years to Keep the Illinois and Michigan Canal in a Navigable Condition.

1881. Joint Resolution.

In a preamble it is recited that the deepening of the canal has become totally inadequate for the purposes

intended, and that the quantity of the sewage of the city of Chicago is far greater than the water of the canal will deodorize or render innocuous;

The foulness of the water destroys millions of fish in the Desplaines and Illinois rivers;

The sewage in an entirely undecomposed and putrid mass is carried by the current of the canal into the Desplaines river and thence into the Illinois river, and in its foulest condition is transported to and below the city of Peoria, rendering the air at all points along its passage so impure and foul as to be exceedingly offensive, taking with it the germs of disease of all kinds, and spreading them broadcast through the entire Desplaines and Illinois river valleys, causing much illness and poisoning the blood and debilitating the systems of 200,000 people;

Careful investigation leads the people to fear that an epidemic may spread over that section of the state;

In addition to this distress there has been a great loss to property, business industries and to the communities in that region ;

Prior to the deepening of the Illinois and Michigan canal the water necessary for all purposes of navigating the canal and propelling machinery was obtained from the Desplaines river and the Calumet feeder through Lane's lake ;

The bed of the Desplaines river at the Summit and thence westward along the line of and adjacent to the canal is, at a low stage of water, eight feet above the surface level of the canal and will average a supply of water sufficient for all canal and power purposes during seasons of navigation ; and

Supplying the canal from these sources will so dilute and weaken the sewage of the city of Chicago as "greatly to relieve it of its foulness and stench, to the great delight, relief and health of the people near to and bordering upon the line of the canal, the Desplaines and Illinois rivers."

The Canal Commissioners are directed to open sluice ways from the Desplaines river to the canal near Summit and at or near Lemont, and also to construct a dam across the former Calumet feeder at such a point as will cause the waters from Lane's lake to flow into the canal :

Provided, They shall first confer with the Mayor of the city of Chicago, and if the city shall proceed without delay to cause to flow into the canal from the Chicago river sufficient water to dilute and purify the water and remedy the evils complained of, the flow to be not less than 60,000 cubic feet per minute, including the ordinary flow from the river, and accomplish this by the first day of September, 1881, the Commissioners shall accept this plan ; and

Provided, The adoption of this resolution shall not commit the State to a system of permanent drainage of Chicago sewage either through the canal or the Desplaines or Illinois rivers, the State reserving the right to require the city of Chicago in future years to take care of its sewage through other channels ; and

Provided, If the city shall erect pumping works, the Commissioners shall allow it to do so upon canal lands in Bridgeport, "and said city shall support, control and manage said pumping works, subject to the direction of the Canal Commissioners, relative to the amount of water to be received into the canal from time to time as the exigencies of the canal may require, but at the expense of the said city of Chicago."

APRIL 28, 1882. Act Ceding the Illinois and Michigan Canal to the United States.

The Illinois and Michigan canal is ceded to the United States for the purpose of making and maintaining an enlarged canal and waterway from Lake Michigan to the Illinois and Mississippi rivers, upon the condition that the canal shall be enlarged in such manner as Congress may

determine, and be maintained as a national waterway for commercial purposes, to be used by all persons without discrimination, this Act to take effect upon a vote of the inhabitants of the State.

JUNE 25, 1883. Act Appropriating \$20,000 for the Maintenance of the Canal for each of the two Succeeding Years.

JUNE 27, 1885. Act Appropriating \$20,000 for the Maintenance of the Canal for each of the two Succeeding Years.

MAY 31, 1887. Act Appropriating \$20,000 for the Maintenance of the Canal for each of the two Succeeding Years.

JUNE 6, 1887. Act to Organize the City of Chicago into a Drainage District.

The city of Chicago is organized as a drainage district and the corporate authorities may exercise the powers conferred by the Act of June 22, 1885, vesting them with power to construct drains, ditches, levees, dykes and pumping works for drainage purposes by special assessment upon the property benefited.

Such corporate authorities may construct a cut-off drain or ditch for the diversion of the flood waters of the Desplaines river into Lake Michigan at some point north of the city of Chicago in aid of any drainage system within the district. The North branch may be widened and deepened if needed for any part of the cut-off. Such cut-off may be used as a drain for the lands through which it may pass.

No more of the water of the Desplaines river shall be diverted by such cut-off than the excess above the ordinary water mark in that stream. During dry weather no water shall be diverted into Lake Michigan, and during floods no

more than 3,000 cubic feet per second shall be allowed to pass the point of diversion down the river.

The city of Chicago may construct and maintain a dam across the Mud lake valley.

MAY 29, 1889. Act to Create Sanitary Districts and to Remove Obstructions in the Desplaines and Illinois rivers.

(Printed in full in Chapter XXVII.)

MAY 27 AND 28, 1889. Joint Resolution Relating to Illinois River Dams and Deep Waterway.

(Printed in full in Chapter XXVII.)

JUNE 4, 1889. Act in Reference to the Improvement of the Illinois and Desplaines rivers and to Repeal an Act.

The Act entitled "An act to cede certain locks and dams in the Illinois river to the United States," approved May 31, 1887, is repealed.

The State works at Henry and Copperas Creek and the river slackwatered by these works are ceded to the United States on condition that the dams shall be removed whenever the depth now available for navigation can be secured and maintained by channel improvement without the aid of the dams.

If these works are not accepted within four years the Canal Commissioners are authorized to remove the dams at Henry and Copperas Creek.

This act of cession is based upon the condition that the plan of improving the Illinois river below La Salle by slack-water maintained by dams and locks be changed to one of improvement by an open channel and water supply from Lake Michigan.

CHAPTER XII.

THIRTEEN YEARS OF PREPARATORY WORK.

It was more than forty years after United States Senator Worthington of Ohio introduced a resolution in the United States Senate relating to internal improvements before a canal between Lake Michigan and the Illinois river was completed. After it had been finally decided that such a canal should be constructed thirteen years were spent in preparation.

This delay was not due to any doubt of the commercial usefulness of the canal. On the other hand there was an almost universal sentiment in its favor. Enthusiasm reached a higher pitch than has been shown over any public work since. But the State of Illinois was financially unable to proceed. The United States Government was slow to recognize the importance of the West and the advantages to be gained by aiding in its development. When a grant of lands was finally and grudgingly made the State lost no time in accepting it. But the lands had little value at first. There was no Chicago, no railroads, and almost no internal commerce. The State was just emerging from a wilderness. To add to other discouragements the engineers who were at last detailed to survey the route of the canal made indefinite and conflicting estimates of its cost.

To sixteen years of agitation and thirteen of preparation there were yet to be added twelve spent in construction and seven in an enlargement for sanitary purposes. The great expectations were ultimately realized. The canal was profitable for many years and its construction fully justified.

When its usefulness in a commercial sense began to wane it served Chicago as an outlet for its sewage and in this capacity fulfilled an unexpected and more important purpose.

The history of the Illinois and Michigan canal may be divided into the following periods:

1. Agitation, - - - - - 1807-1823
2. Preparation, - - - - - 1823-1836
3. Construction, - - - - - 1836-1848
4. Commercial Use, - - - - - 1848-1864
5. Enlargement and Sanitary Use, 1864-189-

The first period has been reviewed in preceding chapters. The second dates from the first canal enactment by the State Legislature. This Act became a law on February 14, 1823. It provided for the appointment of a Board of Commissioners consisting of Emanuel J. West, Erastus Brown, Theophilus W. Smith, Thomas Sloo, Jr., and Samuel Alexander who were directed to carry out the provisions of the Act of Congress passed the previous year. The Commissioners spent \$10,589.87 in preliminary surveys which seem to have had no practical value. The first engineer employed was Colonel Justus Post of Missouri. Accompanied by several of the Commissioners he simply made a tour of exploration along the proposed route. In the fall of the following year Colonel Rene Paul of St. Louis, was employed with a corps of engineers to complete the examination. Five routes were surveyed and an estimate made of the cost of each. These estimates ranged from \$639,946 to \$716,110. The superficial character of the examination is apparent from the estimates.

The Commissioners reported to the Legislature in January, 1825. A few days later, on January 17, the Act was passed creating the Illinois and Michigan Canal association. This association agreed to construct the canal and accept in payment the land bonus offered by the United States Gov-

ernment. Its charter was afterward surrendered through the influence of Daniel P. Cook, Illinois' representative in Congress. Mr. Cook contended that any act which gave to private individuals aid which the canal might receive would defeat the efforts to secure such aid. He foresaw the value of the proposed gift and insisted that the State and not private individuals should receive the benefit. On October 28, 1825, Mr. Cook sent to his constituents a long address attacking the canal policy of the State. He demanded that the rich harvest which the canal was destined to yield should go into the treasury of the State and declared that in thirty years it would relieve the people from the payment of taxes and even leave a surplus to be applied to other works of public utility. To raise capital to construct the canal he was ready to sell or pledge a million acres of the school lands.

The next two years were spent in urging upon Congress the necessity of a more reasonable grant of land. Such a grant was secured by the Act of March 2, 1827. This was followed by the comprehensive Act of the State Legislature on January 22, 1829, which authorized the appointment of three Commissioners to carry out the provisions of the Act. The Governor named as such Commissioners Edward Roberts of Kaskaskia, president, Gershom Jayne of Springfield and Charles Dunn of Pope county. These gentlemen met at Belleville on March 13 and effected an organization. They addressed a letter of inquiry to General Gratiot, in charge of the Government corps of engineers, soliciting the Government's coöperation. They were informed by General Gratiot that United States engineers would reach Chicago about the first of the following October and would at once proceed to locate the Illinois and Michigan canal. The engineers, in charge of Dr. Howard, arrived on the 24th of that month. This was so late in the season that little was accomplished and the force soon returned to Washington.



ROCK IN DRAINAGE CHANNEL AND WATERWAY AFTER BLASTING

Before the departure of the engineers Dr. Howard wrote the Commissioners "that from the examinations and surveys made the canal must be confined to the valley of the river, following the left bank of the Desplaines at its upper portion and the right bank of the Illinois at its lower, the proper point and mode of crossing the Desplaines remaining to be decided by the progress of the survey, the canal to begin on the Chicago creek at the fork near the point designated 'A' by the former Commissioners, and proceeding by a direct course to the valley of the Desplaines, but keeping to the south of the Portage lake."

Acting on information which they already possessed and that which they obtained from Dr. Howard, the Commissioners located the canal at a meeting held on December 21, 1829, at Kaskaskia, and selected the lands donated by the National Government. These lands were advertised for sale in the *National Intelligencer*, published at Washington, the *Albany Argus* and the *Cayuga Patriot*. Sales were held at Springfield on April 19, 20 and 21 and in the following September and October. In the meantime the canal lands at the mouth of the Chicago and Fox rivers had been laid off into town lots. The sales of the lots in the town of Chicago amounted to about \$4,363, and were "so flattering as to inspire the Commissioners," as they themselves reported to the Legislature, "with a confident hope that the remaining lots, say about three-fourths, would, with proper care and management, yield a very handsome increase to the canal fund."

Incidentally the Commissioners had something to say about the future of Chicago. By subdividing the canal lands into town lots, in the latter part of the year 1829, they really founded the great city. Under date of December 27, 1830, they reported to the Legislature: "This town is situated on the Chicago river near its mouth, and possesses many advantages, natural and adventitious. It is

the only eligible site for a town on the lake shore within the limits of Illinois, surrounded by a beautiful, champaign, fertile country, surpassed by none in the richness of its products, and from the long experience of its inhabitants is decidedly healthy. Its prominence, in a commercial point of view, has already prompted merchants from the north-eastern part of this State and northwestern part of Indiana to take their produce to Chicago, ship for Detroit, Buffalo and New York and return by the same route as the safest and cheapest, saving on the transportation of their goods \$1.25 per hundred weight, and performing the trip ten days sooner than by either of the other channels through which merchandise is brought into these sections of the two States. The circumstance of Chicago being located at the head of the contemplated canal will make it the future depot of all the surplus products of the country on the river Illinois and its tributaries. These advantages point out its importance and at once elicit the fostering care of the Legislature of this State."

After the September and October sales the amount of funds on hand was thought to be sufficient to justify a beginning of the work on the canal. Commissioner Dunn remained at Chicago to complete the preparations. He engaged James M. Bucklin, an engineer from the Miami, Louisville and Portland canal, and Colonel Samuel Alexander, a local surveyor, to assist him. They received very little aid from the United States engineers, who had left their field notes taken in Washington, and were ill most of the time during their second visit to Chicago. Commissioner Dunn determined to relocate the line. "On the 20th of October," he afterward reported, "the Commissioner and party left Chicago to perform this labor and returned on the 12th of November following, having completed the examination, surveys and levels on that part of the canal which is included between its entrance into the Chicago river and

the western margin of the Ausaganashkee, or Reed swamp, about $18\frac{1}{2}$ miles from the point of beginning." The Ausaganashkee swamp is now familiarly known as the Sag. The spelling seems to have varied with every writing in the early reports until the present convenient abbreviation was reached.

Engineer Bucklin, in this lightning-like survey, had time also to note the physical characteristics of the country. He said of it: "From the mouth of the Chicago river to the point fixed upon as the entrance of the canal, there is no obstruction whatever to its navigation by boats drawing under five feet for that distance, which is five miles. This river forms a perfect natural canal, its banks being low and of a uniform height, and its waters supplied by the lake.

"Leaving the river at the point above mentioned, the canal inclines toward the Regula and follows along the margin of the Portage lake until it strikes the river Desplaines at the ford, a distance of nine miles. The excavation throughout this distance will pass through a hard ferruginous clay (as has been ascertained by borings) at an average depth of 15.41 feet. From the ford of the Desplaines to the Ausaganashkee swamp the line runs through the valley of the Desplaines river at an average elevation of 16.27 feet above the bottom of the canal. On this part of the route, which is nine miles in length, the excavation to the depth of 6.27 feet is good, consisting of sand and clay, but the remaining ten feet composes a continuous map of limestone, extending with little intermission from the ford of the Desplaines to the end of the line surveyed. It is probably of the same character as that in the bed of the river, the upper strata only of which appear to be detached.

"The Ausaganashkee, or Reed, swamp does not present any insurmountable obstacles to the passage of the canal through it, although with the lake as a feeder it must necessarily be attended with great expense. The canal is

located immediately across its mouth, which is half a mile in breadth, the depth of the excavation rendering it expedient to select the most direct route. The surface of this swamp is 15.86 feet above the bottom of the canal, 9.30 feet above the level of Lake Michigan, and 2.30 feet above the river Desplaines at its low stage. The excavation through it will consist of $5\frac{1}{2}$ feet in depth of mud and earth and 10.36 feet of rock."

Mr. Bucklin's estimate of the cost of the canal through this $18\frac{1}{2}$ miles was \$1,544,497. The bottom of the canal was to be $4\frac{1}{2}$ feet below the surface of the lake. To continue the canal through the deep cut, which would terminate about six miles below the Ausaganashkee swamp, would increase the cost, he thought, to \$2,500,000.

He suggested an alternative plan which would reduce the cost of the canal to \$160,699. He said it was evident from the nature of the ground, as well as from the representations of the inhabitants of the country, that in times of high water there was a communication between the Desplaines and Calamick (Calumet) rivers through the valleys of the Ausaganashkee swamp and Stony creek. Neither of these rivers rose more than ten or twelve feet, and there was no perceptible current between them when both were up. It was therefore reasonable to conclude that the intermediate ground was low enough to permit the waters of the Calamick to be brought into the valley of the Desplaines at a small expense, provided a dam could be made in the former at a sufficient elevation to give the feeder its proper descent.

On the supposition that the Calamick was on a level with the lake from its mouth to the foot of the rapids, a distance of fifteen miles, the erection of a dam at the foot of the rapids, ten feet in height, would raise the waters of the river to within .68 of a foot of the average height above Lake Michigan. It would be necessary to give the feeder a considerable descent, but there was apparently no difficulty

in locating the dam a sufficient distance up the river to secure the required elevation, say, five miles. This distance would probably increase the length of the feeder to 21 miles, allow it a descent of four inches to the mile, and reduce the depth of cutting on the canal to 4.93 feet.

The Commissioners approved the latter recommendation of Engineer Bucklin and advised the necessary modification of the law. A year later Mr. Bucklin found an obstacle to his plans in the prospective damages which the state would be called upon to pay if a dam were constructed across the Calumet river and land in Indiana overflowed. He suggested again, as an alternative to the project for a dam, the construction of a great reservoir in the Ausaganashkee swamp having a capacity sufficient to supply the canal during eight months of the year, depending upon the Desplaines during the remaining four months. Mr. Bucklin seemed to have little confidence in his own plans, and nothing ever came of them.

Commissioners Roberts, Jayne and Dunn are entitled to more than ordinary credit for even the little which they accomplished. They began their work without a cent of public money with which to defray expenses, drawing heavily upon their individual purses until money could be realized from the sale of public lands. They believed the State Legislature would see the wisdom of the policy of prosecuting the work on the canal as rapidly as the means granted by Congress would justify. "It is obvious to every one," they said with a hopefulness which has animated the advocates of an enlarged waterway since, "that when these means are usefully employed and exhausted, the liberal policy of the General Government will bestow further aid to complete a work of so much national importance as the Illinois and Michigan canal is admitted to be by all."

The amount of money in the hands of the Commission on December 1, 1830, available for canal purposes, was

\$12,552.03. The expenses for the two years preceding amounted to \$5,498.58.

The land at the disposal of the Canal Commissioners did not sell as rapidly as had been anticipated, and there were many other discouragements. It was questioned whether it would not be better to abandon the canal and build a railroad instead. The Legislature instructed the Commissioners to ascertain "whether the construction of a railroad is not preferable or will be of more public utility than a canal." Engineer Bucklin was directed by the Commissioners, in compliance with these instructions, to make an investigation. On November 21, 1831, he reported with surprising facility that "the facts elicited by the examination of the route of the proposed canal are unfavorable to the practicability of its safe and economical construction. The route examined for a railway, commencing at Chicago, crossing the Desplaines at Laughton's ford, and pursuing the northwest bank of the Desplaines, was found extremely favorable for the adoption of that species of improvement." Acting Commissioner Dunn reported to the Board that the statements of the engineer confirmed an opinion which he had long entertained, and the full Board, in turn, made the remarkable statement to the Governor that they could not hesitate to say that a railway was decidedly preferable to a canal.

To be certain that the position they had taken was tenable, the Commissioners again instructed Engineer Bucklin to continue his investigations. Mr. Bucklin presented a detailed report on January 1, 1833. He now fixed the probable cost of the canal at \$1,601,695.83. But it was hardly possible, he said, to anticipate the limit of the expenditure, when it was considered that the greater part of the excavation was below the rocky bed of the Desplaines, and that the work was liable to constant interruption from the water of the river which would find its way through the

numerous fissures of the rock into the canal. He reached this startling conclusion:

“In the rocky and cavernous district of country to which the location of the great part of the route of the canal is confined, there are too many difficulties to be reasonably apprehended in carrying it into successful operation to justify the establishment of a water communication on any route or plan whatever. While, however, so many obstacles are opposed to the construction of a canal, the examination of the route for a railway was very successful in developing its great advantages for the adoption of that species of improvement In reviewing the capabilities of the country between Chicago and the foot of the rapids of the Illinois river for the construction of canal or railroad, it would seem (laying aside the great difference of expense) that the obstacles opposed by nature to the formation of a good canal, on any route or plan whatever, are such that nothing could justify the undertaking but the fact of its being the only means of attaining the accomplishment of so important an object as the improvement of the communication between the above mentioned points.”

Below the rapids of the Illinois the conditions were altogether too precarious, Mr. Bucklin thought, to warrant the construction of a canal.

This report, fortified by the growing belief that railroads were to become the only successful means of inland transportation, produced a very decisive effect upon the State Legislature, and an Act was passed on March 1, 1833, abolishing the office of the Canal Commissioners. The Commissioners were instructed to make their final report and settle with the State in full at once.

The people were not willing to permit the valuable grant of lands made by the National Government to lapse, and discussion favoring a canal was soon heard. In his annual message to the Legislature in the fall of 1834, Governor

Duncan made a strong plea for the canal. He said the time had arrived when a proper respect for the interest of the State of Illinois, and all the States, required that the work be commenced without further delay. More than seven years had passed since Congress had made a grant of land, which was then supposed to be sufficient for the construction of the canal, a work which had been generally considered to be of greater national importance than any other of the kind ever proposed in the country. He believed that ample funds could be secured on the most favorable terms for its speedy execution.

The Governor suggested the propriety of reserving all the lands on the route from sale, except town sites, and that loans be effected with which to commence the work. He had no doubt that Congress would make another appropriation to assist in completing the work. "No one," he said, "who has visited the different canals and railroads in the United States and compared the country through which they pass with the fertile lands which lie between the lakes and the Mississippi, to say nothing of the unbounded country that is washed by the 25,000 miles of river and lake navigation which this canal will unite by the shortest and most certain route that can be possibly made, can doubt that it will yield a larger profit upon its cost, in a very few years, than any other work of the kind that has ever been, or can be, constructed in this country."

Governor Duncan said he differed from the late Board of Canal Commissioners and his worthy predecessor on the merits of a railroad. His judgment and experience had taught him that canals were much more useful and cheaper in construction than railroads. When well made, they required less expensive repairs, were continually improving, and would last forever. Railroads were kept in repair at a very heavy expense, and would last only about fifteen years. In the present case, especially, a canal should be preferred,

because it would connect by a short and direct route two great navigable waters that wash the shores of most of the States and Territories of the United States and British Provinces, thus opening a commerce between the remotest parts of the continent.

The Governor referred to the success of the Erie canal and compared the difficulties met with in its construction with the natural advantages along the line of the proposed canal between Lake Michigan and the Illinois river. "Judging of the future by the part and present rapid improvement which is everywhere in progress in our State," he continued, "and estimating its future population by the inexhaustible resources of the country and by the flood of enterprising citizens pouring into it from every quarter of the civilized world, the imagination is lost in contemplating the millions of happy and independent people which it is destined to sustain, and whose surplus produce will scarcely find room to float upon the majestic rivers, the Mississippi and the St. Lawrence, flowing to the north and to the south, which Providence in the fulness of its beneficence has provided on a scale only equalled by the vast country they are destined to accommodate."

The Governor's plea resulted in the passage of the Act of February 10, 1835, which re-authorized the construction of the canal. The Governor was given authority to negotiate a loan for \$500,000 with which to begin the work. Ex-Governor Coles was made president of the new Canal Board. He was delegated to negotiate the loan and he visited several eastern cities. On his return and under date of March 20, 1835, he reported to the Governor that he had been unsuccessful because the faith of the State had not been pledged as security. He had had an offer of \$500,000 in cash for the canal lands. But the offer had come from land and stock jobbers and was not accepted. He had received from New York capitalists the most positive and gratifying assur-

ances of confidence in the State. They were willing to loan the money if the State would satisfactorily pledge its faith as security.

Governor Duncan transmitted the correspondence had with Ex-Governor Coles to the Legislature at its opening session in the following December, and recommended that the loan be authorized on a pledge of the faith of the State. The recommendation was concurred in by the Act of January 9, 1836, which again placed the canal upon a working basis. The Governor appointed William F. Thornton, Gurdon S. Hubbard and William B. Archer Commissioners, and Mr. Thornton was designated acting commissioner. The money needed was secured, William Gooding was elected chief engineer, and work was resumed.

A party was organized early in March and, under the direction of E. B. Talcott, senior assistant engineer, it made a new examination of the Summit division of the Illinois and Michigan canal. Two lines of levels were run across the country lying between Chicago and the Desplaines river near the mouth of Portage, or Mud lake. One commenced near the mouth of the broad slough on the North fork of the South branch of the Chicago river at the point where the former canal surveys were commenced; the other, on the North branch of the river about half a mile above the "point," or the junction of the North and South branches.

The former line, or the route of the old surveys, was found to be the most favorable, the depth of the cutting being much less. It passed over ground but little elevated above the surface of Portage lake at an ordinary stage of water. This territory was generally inundated during the floods of the Desplaines, the waters of which frequently flowed across the low country into the South branch of the Chicago river.

A particular examination was made of Portage lake and of the Desplaines river with the view of occupying portions

of each with the canal should the result prove favorable. But it was found that no saving could be effected by such an arrangement. Portage lake was a succession of ponds on the same level connected with each other and with the Desplaines river and extending about six miles toward the Chicago river nearly in the direction of the canal line. The surface of the water at an ordinary stage was $10\frac{1}{2}$ feet above Lake Michigan, and the mud in the bottom was usually from five to six feet above Lake Michigan, or from eleven to twelve feet above the bottom of the canal. To excavate the canal to the requisite depth through the ponds and the marshes on their borders, it was found, would be attended with great difficulty and at a cost far exceeding that of making the thorough cut along the borders of the marshes on grounds more favorable.

The examination of the Desplaines river resulted less favorably than that of Portage lake. The bed of the Desplaines for $13\frac{1}{2}$ miles below the point where the canal line entered the valley, except in a few places and for short distances only, was from eight to twelve feet above the bottom of the canal, and nothing could be gained by occupying any portion of its channel, as the difficulty of disposing of or keeping out the waters of the river to make the necessary excavation would more than balance the diminution of the quantity to be excavated by such a location.

From the examinations made it soon became apparent to Chief Engineer Gooding that the Summit division was likely to prove far more expensive than any former estimate had made it, and it was believed that if a permanent and adequate supply of water could be provided without cutting down the Summit so as to introduce the waters of Lake Michigan, a change in the existing law should be recommended to the Legislature at its next session. A level was consequently run, in compliance with an order of the Canal Board, from a point on the Desplaines river nearly opposite

the mouth of Portage lake to the Fox river at Elgin, thirty or thirty-five miles south of the State line, with a view of introducing a feeder from that river to make up the quantity which, according to the estimate of Mr. Bucklin, would be required exclusive of the whole available supply to be derived from the Calumet and Desplaines rivers. From the great quantity of water discharged at all times by the Fox river it was known that, if practicable to bring it on to the Summit at a reasonable expense, an unfailing supply could not only be provided for the canal, but a very great saving in the cost of this division effected, and the advantage gained of having the canal completed two or three years sooner than could be otherwise anticipated. But the result of the examination proved unfavorable.

In the lowest depression that could be discovered the ridge was thirty feet higher than the river. The greatest elevation of the dividing ridge was estimated to be fifty or sixty feet above the Fox river.

During the season the line from Marseilles, or the rapids of the Illinois river, to the western termination was revised, and on the 20th of October the work, except the structures, was offered for contract. A portion of the Summit division was advertised for letting in June.

Mr. Gooding's estimate of the cost of the canal from Chicago to La Salle was \$8,654,337.51. This was much higher than any previous estimate.

"The character of the work has not been well understood," said Mr. Gooding, "no minute examinations having been made except by Mr. Bucklin, whose estimate of rock excavation on the Summit division (which forms a large item of the cost of the whole work) was even higher than that now submitted, when the comparative sections of the two canals are taken into consideration. The dimensions of the canal estimated by Mr. Bucklin were as follows: Width at top water line 60 feet, at bottom 26 feet, and depth 4

feet, the cross section consequently 132 feet. Dimensions now estimated, 60 feet wide at surface, 36 feet wide at bottom and 6 feet deep in earth excavation, and the same width at surface and the same depth, but 48 feet wide at bottom in rock excavation ; section in earth 288 feet and in rock 326 feet. Thus it will be seen that the cross section of the canal now estimated is more than twice as great below top water line as that estimated by Mr. Bucklin."

CHAPTER XIII.

PERIOD OF CANAL CONSTRUCTION.

Contracts for the first work on the Illinois and Michigan canal were let on June 6, 1836. The line was divided into three divisions, Summit, Middle and Western. The Summit division extended from the North fork of the South branch of the Chicago river to the first lock at Lockport, but incidentally included the river, about five and one-half miles in length. It was proposed originally to construct a towpath along the south side of the South Branch from the "point," or junction of the North and South branches, crossing the river by a bridge at the mouth of the North fork up which it would continue to the mouth of the slough. The eastern terminus was subsequently changed to its present location.

Chief Engineer Gooding found the prairie over which the line was run to be level and extremely wet except in times of severe drought. The cutting would be chiefly through a stiff blue clay, he said, from seven to nineteen feet deep. In his description of the route he said the canal would continue down the valley of the Desplaines. For thirteen or fourteen miles the river had little descent. The current at low water was scarcely perceptible, and the land along its borders was so low as to be overflowed at every slight rise of the water. After the line of the canal entered the valley the direction was changed by a gentle curve and another straight line obtained of $3\frac{1}{2}$ miles. There were several other straight lines on this division and the curves were all gentle and uniform.

The depth of cutting continued about the same down the valley to Brewer's Ford. From that point the engineer announced that the cutting would be very much more expensive as the excavation was principally in rock. The depth of earth in rock above the mouth of the Saganashkee swamp was found to be much less than was anticipated. A difficult section of canal was encountered in crossing the mouth of the swamp where there was earth to the depth of five or six feet, the most of which was in a semi-fluid state, resting upon rock. The cutting here was about $17\frac{1}{2}$ feet.

From this point to the first lock the rock was generally near the surface. The level ran out a short distance after crossing Big Run, which was about $1\frac{1}{4}$ miles above the first lock and in the bed of which the cutting was about two feet. The first two locks were located on section 23, town 36 north, range 10 east of the third principal meridian, on land belonging to the State. The canal or basin, for about three-fourths of a mile above the first lock was planned to be 120 feet in width. The length of the canal from the beginning to the first lock was 34 miles and 35.78 chains. The estimates on the Summit division were for a canal 60 feet wide at the surface, 36 feet wide at the bottom in earth and 48 feet in rock, and six feet deep. A declivity was given to the bottom of the canal of one-tenth of a foot per mile.

The rock was found to be stratified limestone, the greater part of which, it was believed, could be quarried without much difficulty. The strata adhered to each other so closely as almost entirely to prevent the water from flowing between them, as was feared it might do. The strata were generally from two to six inches thick and of a quality, it was said, suitable for building purposes. The expense of constructing the Summit division of the canal and the time required for its completion were found before the end of the first year of construction likely to be much greater than was

anticipated, but nothing had occurred to diminish confidence in the practicability of the work. The average price at which the contracts for the excavation in earth in the Summit division were let was 33.35 cents per cubic yard, and for that in rock \$1.54.

When proposals were advertised for in the spring of 1836 there were no contractors in this part of the country, and no mechanics or common laborers when the contracts were awarded in June. It was with difficulty that the contractors could secure workmen to build their shanties, or teams and tools with which to begin work. Operations were formally begun on July 4, 1836. The occasion was a memorable one, and Chicago was in a state of considerable excitement. At a signal given by three cannons at Fort Dearborn the citizens assembled in the public square and moved in a body to the scene of the inaugural ceremonies at the head of the proposed canal. Some went by boat and others on foot or with teams along the Archer road. The steamer Chicago started from the foot of Dearborn street with her decks crowded and proceeded up the river. Two schooners and other vessels towed by horses followed, carrying as many people as could crowd upon them.

The locality where the canal was to connect with the Chicago river had been named Canalport and a public house called the New House opened. The crowd collected in front of this public building and saluted Judge Smith as he solemnly read the Declaration of Independence with the characteristic enthusiasm of a pioneer audience. Dr. W. B. Egan followed with an eloquent address, and Gurdon S. Hubbard spoke of the promising condition of the settlement as compared with that of the one he had found eighteen years previous when he ascended the river in a canoe. When one of the speakers in his exuberance of feeling ran along the scale of years and boldly prophesied that Chicago in a hundred years would have a population of 100,000 he

excited the ridicule of his hearers and was hooted off the barrel from which he was speaking. Ground was afterward broken for the canal by Colonel Archer, acting commissioner. Addresses by Judges Smith and Brown of the Supreme Court and Commissioner Hubbard followed.

Work was soon begun, but few laborers were to be had until about the close of the year, when there were 350 at work along the entire line, or so much of it as was under contract. The scarcity of laborers and sickness were the principal causes of delay throughout the entire period of construction.

By the Act of March 2, 1837, the appointment of Canal Commissioners was taken from the Governor and their election assumed by the Legislature. With a more direct interest in the work than it previously had the Legislature appointed a committee to inquire into the probable cost of a canal of the dimensions authorized. Out of the report of the committee grew a dispute over the propriety of continuing the deep cut, the committee contending that the estimates of the chief engineer were far too low, and the engineer maintaining that the work could be done for less than he had estimated. The committee was right and the engineer wrong. But the discussion was dropped within a year and the work continued on the deep cut plan. It was not until the State was absolutely unable to raise the money to carry on the work that it accepted the alternative of a shallow cut and pumping works.

An incident of interest is found in the optimism of Chief Engineer Gooding which seems to have been shared by the Commissioners. By a revision of the plans in 1836 it was provided that the canal in passing through the town of Lockport should be 120 feet wide. A hydraulic basin was to be constructed in such a manner that the mills or manufactories which, it was assumed, would spring up there, might be built upon the banks of the basin and be operated

by the water drawn from it. Upon the side of the buildings next to the canal, and separated from it only by the towpath, there were to be a street and a tier of warehouse lots. The basin was to be connected with the canal in such a manner that boats or vessels could readily pass into it and load or unload at the mills or warehouses.

The value of the water power created there and at other points along the canal, by drawing a supply directly from Lake Michigan, could be fully appreciated, Mr. Gooding said, after a season of such severe drought as the previous one had been. The Desplaines river and many other considerable streams of the country had been nearly dried up, and probably three-fourths of the water mills throughout a large portion of the United States had been standing still for the preceding three or four months. Had the canal been completed there would have been during the season an unusual supply of water, as the surface of the lake had been nine feet and four inches above canal bottom, three feet and four inches higher than was originally counted upon.

Again Mr. Gooding expected phenomenal results at the Sag. "When the canal at this point is completed upon the present plan," he said, "a quantity of state land amounting to about 270 acres will be reclaimed, which is at present entirely valueless. The whole of the impassable marsh that now presents so forbidding an appearance will be made dry land."

On March 2, 1837, the Legislature had authorized a survey and estimate to be made for a canal, diverging from the main trunk of the Illinois and Michigan canal, through the Ausauganashke swamp and lake, to intersect the Calumet river at the nearest practicable point, the work to be constructed whenever the State of Indiana should undertake a corresponding work connecting her system of internal improvements with the Illinois and Michigan canal. "The junction of the canal from the Calumet river with the main

line being made at this point upon reclaimed state land," said Mr. Gooding, referring to the Sag, "will make it one of the most valuable town sites upon the line of the canal, or in the State."

Estimates made by E. B. Talcott, resident engineer in charge of the Summit division of the canal, on December 10, 1837, provided for turning or pivot bridges, the engineer believing that it would be frequently found advantageous to the commerce of the country for lake vessels to navigate the canal as far as Lockport. The formation of a basin at the forks of the Chicago river considered as part of the general plan of the canal, was also embraced in his estimates, and the Legislature, by Act of July 21, 1837, authorized the enlargement of "the natural basin at the confluence of the North and South branches of the Chicago river so as to render the same as useful and convenient as possible."

The many extravagant schemes for internal improvement projected in 1837 injured the State's credit, and canal lands were not easily sold. On April 11, 1839, the Canal Commissioners ordered an issue of checks or scrip payable in ninety days. The total amount issued for that year was \$394,554. This was used in paying the estimates of contractors and meeting other direct expenses. In 1840 the contractors agreed to take \$1,000,000 worth of State bonds at par to 25 per cent discount. These bonds carried the work along until March, 1843, when the expenditures could no longer be met and the work was entirely suspended. More than \$5,000,000 had been spent and the canal was still far from being completed. The expenditures by years were as follows :

1836	-	-	-	-	-	-	-	-	-	\$ 39,260 58
1837	-	-	-	-	-	-	-	-	-	350,649 90
1838	-	-	-	-	-	-	-	-	-	911,902 40
1839	-	-	-	-	-	-	-	-	-	1,479,907 58
1840	-	-	-	-	-	-	-	-	-	1,117,702 00
1841	-	-	-	-	-	-	-	-	-	644,875 94
1842	-	-	-	-	-	-	-	-	-	155,193 33
Superintendence	-	-	-	-	-	-	-	-	-	210,000 00
Contractors' damages	-	-	-	-	-	-	-	-	-	230,000 00
Total	-	-	-	-	-	-	-	-	-	\$5,139,492 03

It became apparent at last that the resources of the State, aided by the unproductive sales of the canal lands, were entirely inadequate to the completion of the canal on the basis of the deep cut. Reluctantly it was agreed by every one that a shallow cut must be made, and that water to operate the canal must be obtained from some other source than Lake Michigan. It had been shown that it was impracticable to construct a feeder from the Fox river to the eastern end of the canal, although there were many who believed it would be cheaper thus to divert the waters of the Fox river than to make the channel of the dimensions originally planned. At last the suggestion was made by Ira Miltimore, who constructed Chicago's first water works, that water might be pumped from the Chicago river into the canal. The idea was endorsed by the Mechanics' Institute and received the favorable consideration of the Canal Commissioners.

It was estimated that it would require \$1,600,000 to complete the canal on the shallow cut plan, and there followed the Act of the Legislature of February 21, 1843, by which the Governor was authorized to negotiate a loan for this amount. As security the Governor was empowered to pledge the canal, its tolls, revenues and lands. The loan was to run for six years and bear interest at the rate of 6 per cent. After the loan was subscribed, three "discreet persons" were to be appointed to constitute a Board, to be known as the Board of Trustees of the Illinois and Michigan

Canal. One was to be appointed by the Governor of the State, and the two others by the subscribers to the loan. They were to possess all the powers and perform all the duties conferred upon the Canal Commissioners.

In the following March, Governor Ford appointed Michael Ryan and Charles Oakley commissioners to secure the loan. They proceeded to New York, where they obtained subscriptions to a part of the amount required. To secure the balance, they crossed the Atlantic and laid the matter before prominent European capitalists, some of whom were already holders of canal bonds. The latter doubted the ability of the State of Illinois to meet its obligations, and insisted on an investigation of the financial condition of the State as well as that of the canal. They agreed to accept the statement of a committee of Boston men, consisting of William Sturgis, T. W. Ward and Abbott Lawrence. This committee detailed Captain W. H. Swift, a United States engineer, and ex-Governor John Davis of Massachusetts, to make an examination of the canal. The latter verified the statements made by Commissioners Ryan and Oakley, and reported that the securities for the proposed loan of \$1,600,000 were satisfactory. The money was then soon subscribed, the contract with the bondholders and the trust deed were executed, and the Trustees were appointed. W. H. Swift and David Leavitt were named by the bondholders to represent them, and Jacob Fry was appointed by the Governor to represent the State.

Work was resumed on the canal in September, 1845, now wholly under the control of the Trustees, and the business of the canal was directed from their office, first in Lockport, then in Boston, and finally in New York. The Trustees were in control of the canal until 1871, when the deepening of the canal for sanitary purposes was completed. At a meeting of the Trustees on April 20, 1846, the plan for pumping water from the Chicago river into the canal

was adopted, and it was also ordered that navigable feeders should be constructed from the Calumet river to the Summit level at or near the outlet of the Sag. The contract for the construction of the Calumet feeder was let in May, 1846, and at the end of the year work on it was in full progress.

Engineer Gooding, in his annual report, covering the operations of the year 1846, gave a careful review of the changes made, and the reasons therefor. He said :

“The existing law for completing the work having authorized a change of the plan of the canal without diminishing its capacity, and the amount of the funds raised for the purpose rendering it absolutely necessary that a cheaper plan than the one required by the original law should be adopted, my attention was early called to the various plans proposed. . . . The only important change proposed, and the only one which, in the then advanced stage of the work, could have resulted in much saving of expense, was the raising of the level upon the Summit division. This, it was supposed, could only be effected by introducing a supply of water from other sources, as a substitute for that which would have been derived from Lake Michigan upon the original plan. . . .

“The original plan was to supply the canal with water from Lake Michigan, except what was to have been derived from the Desplaines and Du Page rivers, as far down as Marseilles ; and from this point to the western terminus at La Salle, the supply was to be received as at present designated from Fox river through the feeder introduced at Ottawa. There could be no doubt that the supply of water for the canal below Marseilles would be ample, at least for the purposes of navigation, and consequently the investigation was more particularly directed to the demands and supply above. It had been ascertained that a feeder from the Kankakee river could be introduced upon the Dresden level, which commences at the Du Page river, at lock No. 7, at a

moderate expense; and it was known that through this feeder a supply of water, to almost any extent for the canal between lock No. 7 and Marseilles might be drawn. It was also known that a feeder from this river might be introduced on the Joliet level, extending the supply up to dam No. 1, in Joliet village. Upon this same level the waters of the Desplaines and Du Page rivers could be brought into the canal, whilst upon the Summit it had been proved that the waters of the Fox and Calumet rivers could be brought through feeders of greater length. It was known, too, that a feeder of some seven miles in length would bring the waters of the Du Page on to the Summit, and that this and a part of the Fox river feeder might be identical. . . .

“The obstacles in the way of this work (the construction of the Fox river feeder) led to a more attentive consideration of the plan for raising a supply of water, in part, from Lake Michigan by steam power. This plan had frequently been recommended by various individuals well acquainted with the application of steam power; but so long as it was believed practicable to procure an abundant supply of water through navigable feeders at a reasonable cost and without serious embarrassment, it was not thoroughly investigated. But measures were now taken to obtain the opinions of scientific and practical men upon this subject and to ascertain the probable cost of erecting the necessary machinery. The president of your Board kindly furnished me the communications upon this subject of several gentlemen, eminent for their science and skill; and the result of the information obtained from these and various other sources was such as to induce me to recommend the adoption of this mode of supply, and for the present not to construct the Fox river feeder.”

In his annual report, dated December 10, 1847, Engineer Gooding refers to the fact that the canal is still unfinished,

attributing the delay to sickness among the employés and to bad weather. Charles Oakley, Trustee for the State, took exception to these excuses, and, in an appendix to the annual report of the Trustees, said: "There has been a culpable delay in the prosecution of the work, and its supposed remote causes are again referred to 'unusual sickness upon the line in the summer and autumn of 1840'—'high water and the scarcity of hands.' Those pleas have served their turn. . . . The places of the sick could have been supplied for the time at least, and the scarcity of hands could have been provided for if proper exertions had been made to do so. . . . The chief engineer now regrets that he is 'compelled to state that the canal is still unfinished,' and were it not for the galvanic shock which I may claim the credit of having administered to him, and which has aroused him from his usual apathy and torpor, he might be 'compelled' to make that statement in another annual report."

This indicates that an extremely bitter feeling had been aroused by the delay in the completion of the canal. When all the circumstances are considered, the delay seems to have been unavoidable. The financial difficulties which nearly wrecked the State itself and temporarily weakened the confidence of capitalists in the canal scheme, the inability of the contractors at times to secure all the laborers needed, the almost continual floods in the Desplaines valley and consequent sickness among employés approaching an epidemic in more than one season, were causes beyond the control of any person. Nevertheless Engineer Gooding was charged with blame so vigorously that his removal was ordered by Governor French on April 18, 1848, but not until the work was practically completed. In the light of all the facts the most severe criticism that can be made upon Mr. Gooding is, that he did not correctly estimate the cost of the canal and permitted the adoption of a plan impossible of comple-

tion within the resources of the State. If he had been more correct in his estimates and less hopeful of the future the work might not have been undertaken at all.

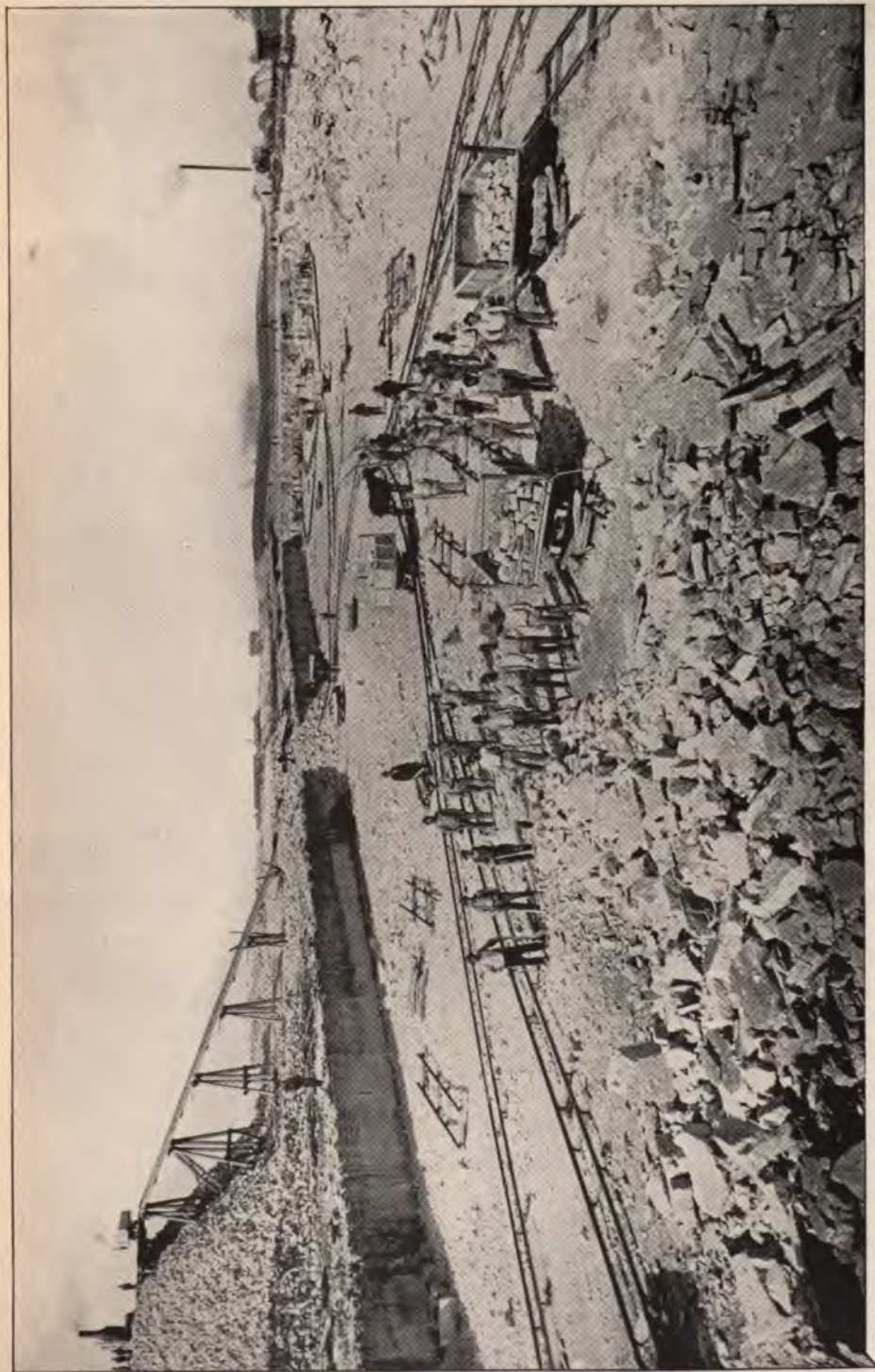
The canal was so nearly completed as to permit a Chicago boat, the General Fry, to pass over the Summit level, from Chicago to Lockport, on April 10, 1848. The formal opening was not announced until April 23, when the General Thornton of LaSalle passed through the entire length of the canal, from LaSalle to Chicago. This boat reached Chicago on April 23, and the event was celebrated by all the citizens.

Nearly twelve years had elapsed since the work on the canal was inaugurated, a period characterized by discouragement and misfortune from beginning to end. Chicago and the State of Illinois owe much to it, for it was the corner-stone of their prosperity. The opening of the canal increased the price of lands in the northern part of the State at once, and immigration was given a new impetus. In 1835, the entire population of the State was only 271,727. By 1840 it had reached a total of 476,183, nearly twice the number of five years previous. Chicago really owes its existence to the canal, having been platted in order that town lots might be put upon the market. Its advantageous location was not fully realized until the canal was completed.

Edward B. Talcott, assistant chief engineer, in charge of the Summit division of the canal, was appointed chief engineer on the removal of Mr. Gooding. He took possession of the office on May 3, 1848. In his annual report, dated November 30, 1848, he states that all the work on the canal had been completed, with the exception of three unimportant items. The total cost of the canal was \$6,537,254.79. Of this amount \$1,401,192.79 had been paid from the \$1,600,000 loan.

Distances on the Illinois and Michigan canal were fixed as follows:

From Chicago to				
Bridgeport	4	miles	Aux Sable.....	56 miles
Summit	12	"	Morris	61 "
Desplaines	21	"	Marseilles	78 "
Athens	25	"	Ottawa.....	85 "
Lockport	33	"	Utica	95 "
Joliet	37	"	LaSalle	100 "
Du Page	48	"	Calumet Feeder Head....	88 "
Kankakee Feeder	51	"	Kankakee Feeder Head..	55 "
Dresden.....	54	"	Fox River Feeder Head..	89 "



REMOVING EXCAVATED MATERIAL FROM DRAINAGE CHANNEL AND WATERWAY

CHAPTER XIV.

COMMERCIAL PERIOD OF THE CANAL.

Free navigation of the canal in the early part of the season of 1848 was impeded by a scarcity of water. From Lake Michigan to the Du Page river, a distance of 44 miles, the entire supply of water was obtained from the Chicago river by pumping, and by gravity from the Desplaines and Du Page rivers. The Calumet feeder, which was expected to supply the Summit level, was not completed until the following year.

From Joliet to the Du Page river, the canal was constructed through a very porous soil. Although the sides and bottom had been lined, it proved to be very leaky. During the months of August and September, 5,000 cubic feet of water per minute were discharged into this section of the canal, but the surface level was raised at the rate of only one inch in twenty-four hours.

The pumping engines proved to be a most important adjunct. The purpose of their construction was to raise water from the river to the Summit level in times of drought. It was not supposed that more than one would be needed after the Calumet feeder was completed, but it was thought prudent to provide two. The cost of the engines was \$27,805.16. Buildings, engines and all other machinery cost \$54,156.69. The pump house was located about 250 feet west of the South branch of the Chicago river and near the junction of the canal and the river. It was 166 feet in length and 55 feet wide, and was constructed of brick and stone. One of the engines operated four cast-

iron cylinder pumps, each 54 inches in diameter and seven feet long. Attached to the other was a wheel 32 feet in diameter, with sixteen float boards or buckets seven feet long working in a trough. The water was lifted by these buckets into a flume which communicated with a basin, the latter discharging into the main canal. The combined capacity of the four pumps was 6,300 cubic feet of water per minute, and that of the wheel 6,370 cubic feet per minute.

About two years before the completion of the canal the Trustees had endeavored to construct a towpath from the canal lock at Bridgeport to the north line of section 16, along the Chicago river, but property holders defeated the plan by excessive demands for right of way. In the spring of 1848 the board renewed the attempt to construct the towpath and began work upon it. An injunction was secured by a property holder in section 21, and the work was stopped at the southeast quarter of that section. The towpath had been completed for about one-half the distance from the head of the canal to the junction of the two branches of the river. Failing in this undertaking the board authorized the construction of a steam tug to be used in towing boats along the river. It proved defective and was laid aside. A tug was then hired at the rate of \$27.50 a day to make stated trips and haul such boats as were offered. The same rates were charged for towing on the river as were charged on the canal. The trustees soon found they were losing money and canal boats were left at the head of the river to shift for themselves.

Very few boats were ready to traverse the canal at its opening. This was believed to be due to rumors which had been circulated that the canal would not be ready for use before June or July. Only fifteen boats were registered before the first day of June. The total at the end of the year was 162, a fair average for the season. In the opinion

of Chief Engineer Talcott sufficient business had been done to demonstrate the economy of the canal mode of carrying produce and merchandise, and to insure for the coming season a line of steamboats exclusively for towing canal boats at fair prices.

“With this arrangement,” he said, “the river may be very properly regarded as an extension of the canal,—300 miles to St. Louis. Assuming then that the markets are equal, the economy of shipping grain in bulk by canal boats over the usual mode of sacking (which is necessary when shipping by steamboats) must give to Chicago a liberal share of the river trade. To divert business from an old and familiar channel to a new one requires not only time to form new associations, but an actual demonstration of the benefits resulting from it. Operations of the past season have at least directed the attention of forwarders to this route, and I feel confident that each succeeding year will more firmly establish its economy and witness a rapid increase in the business and revenue of the canal.”

Extravagant hopes of the future of the canal were entertained. Charles Oakley, State Trustee, said in his report to the Governor on December 2, 1848, that notwithstanding all the disadvantages resulting from a lack of water and defects in construction, the canal had made a beginning which augured well for its future success. The rapid increase in the population, of the State would necessarily create a corresponding increase in trade. From this a large revenue would be derived, by means of which the canal debt would be finally discharged, probably much earlier than was anticipated. Without the drawbacks mentioned the tolls of the season just passed would have been \$150,000 instead of \$86,000.

“We may congratulate ourselves,” Mr. Oakley said, “on the ultimate success of what was once conceived to be a visionary project. We have, after struggling through

many difficulties and surmounting obstacles which might have damped the energies of States possessing greater resources, prosecuted to completion a great public work. We may say it is done. The doubts of the timid have no longer a resting place, and the anticipations of its most sanguine friends will be more than realized. As a work of art it will bear a comparison with any structure of the kind in the world, and as a channel of trade and revenue we cannot overestimate its benefits. It has given an impetus to the growth and prosperity of Chicago which has already excited the envy of rival cities."

In their report for the year 1848 the Trustees speak of it as a matter of considerable interest that sugar and other merchandise from New Orleans, brought to Chicago by the General Thornton on its first trip through the canal, were received at Buffalo by way of Mackinaw two weeks before the first boat reached Buffalo by the Erie canal. As the Straits of Mackinaw were not usually open until after Lakes Michigan and Erie were free from ice, it was clear to the Trustees that with the Michigan Central railroad completed from New Buffalo to Detroit, the Illinois and Michigan canal could be advantageously used for throwing in supplies for Lake Erie from New Orleans and the Mississippi some weeks before the lake region could be supplied from the east by the Erie canal.

Governor French shared the universal optimism. In his annual message to the State Legislature on January 2, 1849, he said: "The Illinois and Michigan canal, which for so long a time remained in an unfinished condition and was the cause of so many fruitless struggles, is at length completed, and from the success attending its operations thus far seems destined to realize the hopes of its warmest friends."

In spite of the flattering prospects tribulations soon fell upon the canal. The first were found in destructive freshets. There was one in December, 1848, and another in March of

the following year. In the latter year the Desplaines river overflowed the entire valley. It caused serious breaches through the towpath of the canal and deposited large quantities of material in the canal. The feeders also sustained considerable damage.

It became necessary as early as the spring of 1849 to hold out inducements for trade. In May the trustees offered a drawback of 50 per cent "on such of the following named articles as might pass from the Mississippi river to the Hudson via the Illinois and Michigan canal, viz., beef, pork, bacon, lard, flour, tallow, wool, tobacco, hemp, beeswax, furs and peltries; and on the following articles passing from the Hudson to the Mississippi via the Illinois and Michigan canal a reduction of 25 per cent, viz., dry goods, groceries, hardware, crockery and glassware and some minor articles; upon salt and lumber from the lakes to the Mississippi, 25 per cent drawback, and upon white lead and shot from the Mississippi to the lakes 50 per cent drawback." This action was taken, as the Trustees explained, "with a view of inducing a portion of the trade between the East and the West, which usually passed by the Ohio river, to take the route by the Illinois and Michigan canal."

In 1850, wheat and other breadstuffs, instead of passing through the canal from the Illinois river to Lake Michigan, unexpectedly took the opposite direction. Large quantities of these commodities were drawn from Michigan and even from points as far east as Buffalo for the supply of the St. Louis market, the prices there having been such as to create this unlooked for diversion. Articles of food which would have sought a market eastward by way of the canal and lakes were thus withdrawn from the Illinois river. Boats carrying lumber, salt and merchandise out from Chicago were compelled to return from the Illinois river without freight. In addition to these untoward circumstances, the Trustees complained, cholera made its appearance, water in

the Illinois river was unusually low from the middle of May to the middle of August, there were breaks in the canal at the busy season, and, finally, higher prices were paid in St. Louis for produce than in Chicago.

Up to the year 1851 it had been supposed that considerable produce would be shipped from the Calumet river feeder to Chicago. The Trustees came to the conclusion that shipments were prevented to some extent by the fact that boats traversing the feeder could draw only three feet of water. They found that the Michigan Central and Michigan Southern railroads would have connections reaching to Chicago completed before the next season, consequently very little business could be expected from the Calumet region thereafter. Nevertheless it was proposed to deepen the Calumet feeder. In the following year ledges of rock were removed producing a uniform depth of four feet.

In 1852 the low water in the Illinois river from the middle of July to the middle of September greatly diminished the business of the canal. The river between La Salle and Henry, a distance of about thirty miles, was less than twenty inches in depth over the bars. Between the 18th of July and the 1st of November first-class steamboats could not reach La Salle. The tolls received in 1852 were less than those of 1851 by \$4,723. The loss was attributed solely to low water in the Illinois river.

Congress made an appropriation in August, 1852, of \$30,000 to be applied in dredging the Illinois river, but the low water from June 20 to November 5 in the following year was again a serious detriment to the carrying business of the canal. Large steamboats were unable to navigate the Illinois river, "an evil," the Trustees said, "which calls upon the General Government of the United States loudly for a remedy." The Trustees hoped the small appropriation made by Congress would be judiciously applied, and that a further sum would be granted sufficient

for a substantial and permanent improvement of the river, "commensurate in some degree with the extent of the great and constantly increasing interests which are dependent upon the line of water communication between the Mississippi river and the great lakes for their carrying business."

"All who have exact knowledge upon this subject," the Trustees said in 1853, "believe the improvement of the river to be an object of easy accomplishment and one to be effected at comparatively moderate cost. Until the Illinois river shall be improved, say in such a manner as shall secure a constant depth of three feet, the advantages which the State promised herself by the construction of the Illinois and Michigan canal, and for which she has expended so much money, cannot be realized; nor can the wants of the community, in the interchange of commodities, be supplied until this improvement is accomplished."

Compared with the previous year, there was an increase in the tolls received in 1853 of \$4,794.81, but there was a falling off of an equivalent of 1,231 boats and 25,966 passengers passing through the entire length of the canal. The decrease in the number of boats was due to the low water in the Illinois river, and of the passengers to the opening of the Rock Island railroad.

During the year 1854 the loan of \$1,600,000 was paid with the exception of \$3,231.54 due in Illinois. There had been received on the loan \$1,569,828. The total amount paid on its account, including interest, discounts, expenses, etc., was \$2,114,199.70. The following statement made by the Trustees on November 30, 1854, gives the cost of the canal, the receipts from tolls and other items:

Classification.	Receipts.	Expenses.
Loan of \$1,600,000.....	\$1,569,828 00	\$2,114,199 70
Construction of Canal and Feeders	2,132 25	1,429,606 21
Canal Lands, Sales, Protection, etc	2,370,314 98	72,827 21
Interest on Registered Bonds, etc.....		558,793 38
Maintenance and Repairs Canal, etc	4,545 94	352,632 04
Tolls, Collections, Inspection, etc.	1,045,340 49	40,200 16
Canal Damage, Flowage, etc.....		15,557 07
General Expenses and Contingencies...	3 00	183,030 85
Interest and Exchange	82,870 67	3,656 47
Aggregate.....	\$5,075,035 33	\$4,800,503 12
Over Credit in the Receipts of 1853....		124 00
Balance to Credit of Fund, November 30, 1854		274,408 21

The \$1,600,000 loan having been paid, the proceeds of sales of canal lands and town lots and the net revenues of the canal were thereafter devoted to the payment of arrears of interest on registered bonds and other registered securities, and to the redemption of the principal of the remaining debt. Although the loan had been paid the trust authorized by the act of 1843 was not fully executed until the principal and interest due to bondholders and all other evidences of canal indebtedness had been extinguished. This was not accomplished until April 30, 1871. On the following day the canal reverted to the State.

Notwithstanding a reduction in the rates of toll and the loss of the greater part of the passenger business, the gross revenues of the canal in 1854 were \$25,000 larger than the year previous. Commenting on the ability of the canal to compete with the railroad, the Trustees said it was not the railroad competition the canal had to fear, but the lack of sufficient water in the Illinois river. With the river available for boats drawing four feet of water for the eight or nine months of the year in which the canal could be used there would be nothing for the friends of the canal to ask. So long as the Illinois river remained in its existing condition, unimproved either by the State or the United States, so long would the canal lie partially idle one-half of the season of navigation. The revenues of the canal might just as

well be \$500,000 per annum as \$200,000. All that was required was an outlay of \$1,200,000 to \$1,500,000 in improving the Illinois river by a system of slack water navigation between La Salle and the Mississippi river. Until such improvement was effected interruptions to continuous navigation must be looked for, and the State could not hope to realize a tithe of the full advantages which she promised herself by the construction of the canal.

During the year 1855 there was a falling off in the tolls of nearly \$18,000. The more favorable condition of the market at St. Louis in the early part of the season, due to a lack of provisions in the valleys of the Mississippi and the Ohio, was specified as one of the causes. Short crops along the Illinois river in 1854 contributed to some extent toward the depression. Again the Trustees lamented that the canal must continue to be a work of secondary importance until the Illinois river should be made navigable at all seasons for boats drawing at least three feet of water. "This object," they said, "so easily accomplished and comparatively at such moderate cost, must remain unattempted, we fear, until the same kind of spirit which carried through the Illinois Central railroad so successfully shall make its appearance in another shape. The canal and river navigation are slower channels of communication, we know, but with the river improved, quite as sure and certainly much cheaper than any railroad can be."

In 1856 the situation became still more harassing. John B. Preston, general superintendent of the canal, advised the Board of Trustees that the business of the canal had suffered severely on account of the unusually low water in the Illinois river. From the middle of June until November there were not more than twenty inches of water on many of the bars, virtually suspending navigation on the river for six months. The revenues of the canal from grain, lumber and other articles to and from the Illinois

river were \$55,000 to \$60,000 below a reasonable estimate of what they should have been with four to six feet of water on the bars. In Mr. Preston's opinion, a permanent improvement of the Illinois river, which would give six feet of water and permit the passage of boats of 800 to 1,000 tons from St. Louis to La Salle, would reduce the cost of transportation on that river one-half upon produce and lumber, and open a reliable communication to one of the most productive portions of the State wholly closed during three-fourths of the season just passed.

The Trustees endorsed all that Mr. Preston said, and emphasized it by adding: "The Mississippi river on one side and Lake Michigan on the other are the true termini of the canal, and until the communication by water between La Salle and St. Louis can be made certain for navigation, say from March to December, the period during which the canal is free from ice, this great work must be subjected to the risk of just such interruption to its usefulness as has happened this year, to-wit: three-fourths of it rendered entirely unavailable for purposes of navigation."

Low water in the Illinois river and other misfortunes may have checked the prosperity of the canal during the early years of its existence; yet, the canal must be considered to have been a phenomenal success. The annual land sales in Chicago attracted settlers, and money was more plenty in Chicago than in any other city in the country. During the first ten years of the canal's existence there were transported through it approximately 563,000,000 feet of lumber, 27,000,000 pounds of pork, 26,000,000 bushels of corn, 5,500,000 bushels of wheat, and 50,000 tons of coal. The tolls collected at Chicago alone amounted to more than \$1,000,000. The high water mark in tolls during the first decade was reached in 1854, when they amounted to \$198,326. In 1859 they dropped to \$132,140.

The War of the Rebellion improved the conditions, and in 1861 the collections amounted to \$218,040; in 1862 they were \$264,657. Again there was a decline to be followed by an upward turn, the collections reaching the sum of \$302,958 in 1866. This was the largest total of any year in the history of the canal.

The lack of sufficient water in the Illinois river was the burden of complaint in succeeding years as it had been during the first decade. When the deepening of the canal by the city of Chicago was in progress in 1867 the Trustees were prompted to say that whether the canal had a depth of six or eight feet it mattered little so long as its great feeder, the Illinois river, remained unimproved. Up to that time, or at the end of the first twenty years, the average yearly receipts from tolls had been \$189,077. The average yearly cost of repairs and renewals had been \$617 per mile.

The Trustees relinquished control of the canal on April 30, 1871, and on the following day the property was out of pawn and again in the possession of the State. On April 30 the Board of Trustees rendered the following statement of account with the State of Illinois, covering the period from June 26, 1845, the date of the execution of the deed of trust, to April 30, 1871, inclusive:

DEBIT.

Loan of \$1,600,000, Principal and Interest.	\$1,601,891 90
Construction of Canal, Feeders, etc.	2,132 25
Canal Bonds, Sales, Protection, etc.	4,706,482 68
Maintenance and Repairs of Canal and Feeders.....	111,003 97
Tolls, Collections, Inspection and Salaries	4,405,658 27
General Expenses and Contingencies	3 00
Premium on Gold for Dividends on Bonds Payable in	
London	923 27
Interest and Exchange.....	181,412 07
Total.....	\$11,009,507 41

CREDIT.

Loan of \$1,600,000, Principal and Interest	\$2,158,771	81
Construction of Canal, Feeders, etc.	1,429,606	21
Canal Bonds, Sales, Protection, etc.	115,523	23
Arrears of Interest on Registered Bonds	2,155,622	88
Principal Registered Bonds	2,195,463	67
Maintenance and Repairs Canal and Feeders	1,858,049	61
Tolls, Collections, Inspection and Salaries	160,462	71
Canal Damages, Flowage, etc.	23,163	82
General Expenses and Contingencies	421,600	82
Premium on Gold for Dividends on Bonds Payable in London	370,864	42
Interest and Exchange	21,078	80
Losses on "Wild-Cat" Currency, Counterfeit Bills, Broken Banks, etc., 1848 to 1863, inclusive	14,563	52
Balance in Hands of Treasurer of the Board of Trustees April 30, 1871	95,742	41
Total	\$11,009,507	41

CHAPTER XV.

CHICAGO RIVER AND HARBOR CONVENTION.

Although Chicago and the greatest of the western States owe so much to the Illinois and Michigan canal, it had a pronounced national importance. Through its agency the distant West was brought near to the East,—near, as time and distance were reckoned half a century ago,—and it may be said to have become the bond which united the East and the West indissolubly. Until a few years before the War of the Rebellion political issues were divided by a line running north and south as well as by one extending through the country from east to west. This fact is illustrated by President Polk's veto of the river and harbor bill on August 3, 1846. This veto prompted the great river and harbor convention held in Chicago a year later.

In the bill referred to there were a number of items ranging from \$5,000 to \$80,000 for the improvement of harbors on the inland lakes and some of the larger rivers, Hudson river above and below Albany among the others. The item of \$80,000 was intended for the benefit of the harbors at Racine, Little Fort, Southport, Milwaukee and Chicago, including the cost of a dredge boat. Mr. Polk thought it prudent to husband the means of the country, "and not waste them on comparatively unimportant objects." Some of the objects of the appropriation contained in the bill, he contended, were local in their character and within the limits of a single State. Although in the language of the bill harbors were specified, they were

not connected with foreign commerce, nor were they places of refuge or of shelter for the country's navy or commercial marine on the ocean or the lake shores.

These were considered sufficient reasons for a veto of the bill. The resulting indignation of the people was not local. Before rebellion was tried and found a poor weapon for the redress of real or fancied wrongs, war was a convenient and not always an ineffective threat. "If no measures for protection and improvement of anything North or West are to be suffered by our Southern masters," said the *Chicago Daily Journal*, "if we are to be downtrodden and all our cherished interests crushed by them, a signal revolution will ensue. The same spirit and energy that forced emancipation for the whole country from Great Britain will throw off the Southern yoke. The North and the West will look to and take care of their own interests henceforth."

In a calmer mood the same journal called attention to the fact that in a few years the trade and commerce of the lakes would nearly equal that of the Atlantic. "When the various arteries to the main channel shall have been opened, —especially when the boundless West shall have poured in her tribute through the Illinois and Michigan canal,—the increase in the amount of produce will be immense and the tonnage on the lakes will increase in proportion. Through this channel, most probably, the States and Territories bordering on Lakes Michigan, Huron and Superior, including the copper region, will be supplied with the necessities and luxuries of life from the tropical regions, thus creating an entirely new era in the commerce of the West."

Public feeling was reflected by other newspapers in the West, and a definite suggestion for a national convention was made by the *St. Louis Republican*. It proposed that men in office should be convinced by the moral force of the popular will that the Government was framed for the benefit of the people, and that they would exact from their

agents the benefits and assistance they had a right to expect. On the evening of September 28, 1846, a meeting was held in New York to encourage the movement, the call for which summoned together all those who resided on the borders of the northwestern lakes then in New York, and all others interested in the improvements of the harbors on those lakes.

Resolutions were adopted endorsing the suggestion for a convention. Chicago was recommended as the most suitable place and June 17 of the following year as a favorable time. A public meeting was held in Chicago in November following the New York meeting and active preparations for the convention were begun. Among the active participants at this meeting were John Wentworth, J. Young Scammon, Isaac N. Arnold, Norman B. Judd, Grant Goodrich, Thomas Hoyne, William B. Ogden, Mark Skinner, John H. Kinzie, Walter L. Newberry, Jesse B. Thomas, Gurdon S. Hubbard, David M. Bradley, Ira Couch, Philip F. W. Peck, Alfred Cowles, William B. Egan, Levi D. Boone and Robert D. Sherman. No citizen of prominence, whose name has since become historic, was absent from the meeting.

An address to the public was issued. In it the attempt to give the convention a political significance was deplored. The construction of harbors upon the northern lakes as well as upon the Atlantic, and the improvement of the great rivers where commerce was of a national character, necessarily involved no questions of party difference. It was shown that there had been no scruples on the part of the national administration down to the time of President Polk against signing bills for the improvement of rivers and the construction of harbors. After the General Government had expended more than \$17,000,000 for works of internal improvement, principally in the old States, by the consent and support of the very framers of the Constitution and their contemporaries, and by men of all political parties, but little consideration could be given to the cry that it was unconsti-

tutional, or the plan of any party to extend the advantages of new works to the new States.

A general convention might be the means of disseminating the information then lacking as to the necessities of the West. There was not a State in the confederacy that did not touch the lakes, the ocean, or the great rivers of the West. The lakes stretched along almost our entire northern frontier and separated us from a foreign country, and the rivers like arteries ran through the whole country constituting an extent of navigation sufficient to reach around the globe. These great waters were soon to be united by the Illinois and Michigan canal. The commerce of Boston, Philadelphia, Baltimore, New York, New Orleans, Cincinnati, St. Louis, and indeed the whole country, would then become in a great measure connected. This commerce had a common interest. No injury could arise from a common consultation, and there might result the greatest advantages.

Although the construction of harbors and the improvement of rivers would be the principal subject before the convention, whatever related to the prosperity of the West and to the development of its resources would come properly before it ; all plans and suggestions would be freely entertained.

The committee on address invited a general attendance from all sections of the Union, and tendered, in behalf of their fellow citizens, the hospitality of the city of Chicago. The members of the committee who prepared the address were John Wentworth, George Manierre, J. Young Scammon, I. N. Arnold and Grant Goodrich.

The date of the convention was changed to July 5, 1847. In the interval meetings were held in all the States endorsing the proposed convention. The result was a gathering of distinguished men such as the country had never before seen. Chicago's population in 1847 was only 16,000, but the

attendance at the convention is said to have been 20,000. Of this number 10,000 were accredited delegates. Horace Greeley was present both as a delegate and as a reporter, and a complete report of the proceedings was made by him for the *New York Tribune*. Thurlow Weed was a delegate from New York, and he personally reported the proceedings for the *Albany Evening Journal*.

Abraham Lincoln, who had just been elected to Congress from the only whig district in the state of Illinois, and whom Horace Greeley characterized as "a tall specimen of an Illinoian," was a delegate. This was his first visit to Chicago.

Schuyler Colfax came as a delegate from Indiana, and was made a secretary of the convention.

New York State sent about three hundred delegates. Besides Greeley and Weed there were David Dudley Field, Alvin Bronson, Amasa Wright, Erastus Corning, Andrew White and John C. Spencer. Massachusetts was represented by Anson Burlingame, Henry Loring, Jr., William T. Eustis and Eleazar Porter. There were eight distinguished men from New Jersey, and twenty-seven from Pennsylvania. Georgia sent two representatives, one of them Thomas Butler King. There was one delegate each from South Carolina and Florida. New Hampshire was represented by two. Nineteen States were sufficiently interested to send delegates. But the largest representation came from Illinois and other western States.

The proceedings of the convention were held in a large tent in the public square bounded by Clark, Washington, La Salle and Randolph streets. Preliminary to the opening there was a parade through the streets, of which Horace Greeley said, "the spectacle was truly magnificent." "The citizens of Chicago, of course," he added, "furnished the most imposing part of it,—the music, the military, the ships on wheels, ornamented fire engines, etc. I never witnessed anything so superb as the appearance of the fire

companies with their engines drawn by led horses, tastefully caparisoned."

The principal emblem seen in the procession was a ship with all sails set and signals flying, drawn by eight horses and manned throughout by sailors. This was typical of the object of the convention. The citizens were fairly delirious with joyous excitement. "At an early hour," according to the *Chicago Evening Journal*, "the streets were thronged with strangers, the gray haired and the young, the matron and the maid, the hope and the promise of a coming day, and the veteran of his three score and ten. Flags were flying from every steamer and sail vessel in port, blasts of martial music swelled ever and anon upon the air, and the deep notes of artillery boomed over the prairie and the lake. Joyous faces were everywhere, and Heaven itself smiled upon the scene. At 9 o'clock the roar of cannon and the roll of drums announced the hour for the formation of the procession. The fort, Water, Lake and Washington streets were alive with the military, the fire companies and the civic procession. Column after column and line after line, away they moved to the rendezvous; banner after banner, band after band, host after host. It was a glorious, almost a sublime spectacle, worthy the time ere Babel left the world. Five thousand men, *five* thousand *freemen*, in solid column moving on, not to carnage, but to the expression of a great truth, the pleading of a great necessity, the arguing of a great cause."

The convention assembled at 12 o'clock and elected Edward Bates of Missouri presiding officer. Thurlow Weed says an immense throng of citizens gathered around the seats provided for the convention. "An army of reporters" was seated on either side of the president. "This is undoubtedly the largest deliberative body that ever assembled," was Mr. Weed's opinion. "In looking around the sea of faces turned toward the chair I recognize

from various parts of the Union men of distinguished talents. Among the most prominent are Senator Corwin and Governor Bebb, ex-Governor Morrow of Ohio, Andrew Stewart, Joseph R. Ingersoll of Pennsylvania, Thomas Butler King of Georgia."

The convention was first addressed by Rev. William Allen, a delegate from Massachusetts. He sought to show "that the land of the Puritans was the hive from which swarmed the intelligent and enterprising settlers who were now developing the agriculture of this boundless and fertile region."

Thomas Corwin of Ohio was called before the convention and made a characteristic speech. In it were covert but pertinent allusions to the delicate distinctions made by the Memphis convention the year previous between objects which the General Government could legally aid and those it could not. The following paragraph is from Corwin's speech as reported by Thurlow Weed:

"Congress has power to regulate commerce between the several States. If you send a cargo of wheat from Chicago to Buffalo, a distance of 1,000 miles, crossing lake after lake, stretching away in their magnificent length, would not one naturally think that this might be called commerce? But no, that is a mistake, we are told. What is it then, my brother? Why that is trade (a laugh). But if you send the same cargo from New York to New Orleans, what is it then? Well, then, it is commerce. Why is it not in the first instance as well as in the last? Oh, it is not on salt water (a laugh). He begged gentlemen would notice this nice distinction between commerce and trade. If we are engaged in business upon salt water it is commerce. If upon fresh water, then it is trade (a laugh). Such is the beautiful construction of that clause in the Constitution, as given to it in various parts of the Union. If you are desirous of knowing the construction of that clause, recollect,

you are not to ask the opinion of some able lawyer or erudite statesman, but you must seek some distinguished chemist and have the water carefully analyzed to discover whether it is salt or fresh (a laugh).''

On the second day letters were read from public men who were unable to be present. Thomas H. Benton of Missouri wrote that the lake and river navigation of the great West very early had a share of his attention, and he never had a doubt of the constitutionality or expediency of bringing that navigation within the circle of internal improvement by the Federal Government, when the object to be improved should be one of general and national importance. The junctions of the two great systems of water which occupy so much of our country,—the northern lakes on the one hand, and the Mississippi river and its tributaries on the other,—appeared to him to be an object of that character, and Chicago the proper point for effecting the union. Nearly thirty years previously he had written and published articles in a St. Louis paper in favor of that object, indicated and almost accomplished by nature herself and wanting but little from man to complete it.

Articles in the *St. Louis Enquirer* of April, 1819, expressed the opinions he then entertained. A report to the secretary of war on this subject, which was written by himself, Mr. Benton said, was, he thought, the first formal communication upon authentic data in favor of the Chicago canal. Messrs. Graham and Phillips, with John C. Sullivan of Missouri, having been appointed by the secretary of war to run a line from the south end of Lake Michigan to the Mississippi, Mr. Benton proposed to them that they examine the ground between Chicago and the headwaters of the Illinois river with a view to the construction of a canal by the Federal Government. They did so, and on their return to St. Louis submitted all their observations to him, Benton ;

hence the publications in the newspapers and the report to the secretary of war.

Henry Clay wrote that he cordially concurred in what was announced to be the object of the convention, and that he should be happy to assist in the accomplishment of it if it were in his power.

Martin Van Buren begged the convention to be assured that it did him but justice in assuming that he was by no means indifferent to its objects. Having visited the most distant parts of the interesting West, and witnessed with admiration and high hopes its peculiar capacities for improvement, he could not but wish success to all constitutional efforts that have that direction.

In a letter received too late to be read at the convention Daniel Webster insisted that he was a firm advocate of the improvement of the rivers and harbors of the West. "Does anyone suppose," he asked, "that any government or any administration can receive any support and confidence which refuses all harbor improvements to the city in which the convention is now to assemble? Chicago, a commercial place of recent origin, is already a large city. It is the seaport of Illinois. It is now accessible by vessels from the Atlantic ocean. It is also on a great line of internal communication from Boston and New York to New Orleans. Shall it have no convenient harbor? Shall it be able to afford no safe refuge for property and life from the storms which vex the lake?" Mr. Webster was sure he would see the cause of internal improvement triumph by decided majorities. He would see the noble rivers of the West cleared of their obstructions. He would see the great internal improvements of the country protected and advanced by a wise, liberal and constitutional exercise of the powers of government.

Letters were received from Silas Wright of Ohio, Governor Alpheus Welch and General Lewis Cass of Mich-

igan, Thomas B. Curtiss and Joseph Grinnel of Massachusetts, Bradford R. Wood, George P. Barker and Washington Hunt of New York.

The resolutions adopted contained no specific recommendations, but sought to prove that the distinction between objects of national and local importance was not well founded. It was urged that Congress, possessed of the means and power which had been denied to the States, became obligated to provide the facilities and the protection which the States individually would have afforded had the revenue and the authority been left to them.

An export from the American shore to a British port in Canada was as much foreign commerce as though it went directly to Liverpool. An exportation to Liverpool neither gained nor lost any of the characteristics of a foreign export by the directness or circuitry of the route. It was the same whether it passed through a custom house on the British side of the St. Lawrence, or descended through that river and its connecting canals to the ocean, or whether it passed along the artificial communications and natural streams of any of the States of the Atlantic. The General Government, by extending its jurisdiction over lakes and navigable rivers, subjecting them to the same laws which prevailed on the ocean and on its bays and ports, not only for purposes of revenue but to give security to life and property by the regulation of steamboats, had precluded itself from denying that jurisdiction for any other legitimate regulation of commerce. If it had the power to control and restrain it must have the same power to protect, assist and facilitate. If it denied jurisdiction in the one mode of action it should renounce it in the other.

Finally, the resolutions declared that the convention was utterly incapable of perceiving the difference between a harbor for shelter and a harbor for commerce, but it believed that a mole or pier which would afford safe

anchorage and protection to a vessel against a storm must necessarily improve such harbor and adapt it to commercial purposes.

In the discussion of the resolutions, David Dudley Field sought to make the distinction that national aid should be given to the construction or the improvement of the waterways which traversed more than one State; those lying wholly within a single State could not be constitutionally aided. In his report of the proceedings, Horace Greeley thus quotes and answers him :

“ In the same mistaken spirit (referring to Silas Wright), Mr. David Dudley Field of our city, when arguing before the convention in favor of a ‘ strict construction ’ and displaying the awful perils of latitudinarian views and policy on this subject, being asked, ‘ Do you consider an appropriation for the improvement of the Illinois river constitutional ? ’—‘ Does it run through more than one State ? ’ was his Yankee answer. ‘ No, no, ’ responded a hundred voices. ‘ Then I do not consider it constitutional, ’ was his response. Now the principle here aimed at may be sound yet the application be flagrantly blundering. A river may be wholly in one State, yet its navigation be immensely important to a dozen,—as the Hudson, for example,—while another may run through two or more States, yet its navigation be far less important to any or all. Thus the Chesapeake and Delaware canal, only a few miles long, lying wholly within the limits of the smallest State in the Union, is plainly a work of great national importance, while the Delaware and Hudson, ten times as long and penetrating two great States, is palpably local in its character and uses. Mr. Field’s distinction is ill taken and worthless.

“ ‘ But do you hold that the Hudson may be constitutionally improved ? ’ was the next question. ‘ Below a custom house it may, ’ replied Mr. Field. Here was revived in essence the very distinction between salt and fresh water

improvements which Mr. F. had just before most emphatically repudiated. And is it not a most fallacious and irrational distinction? Consider its practical effect in filling the country with inland custom houses,—at St. Louis, at Albany, at Pittsburg, etc.,—to the pernicious multiplication of offices and the sensible increase of our public burdens. Who can seriously regard it as more constitutional to improve the Ohio with a custom house at Pittsburg than if the goods had paid duties at Cincinnati, Louisville, or even New Orleans? Who does not see that the doctrine here enunciated makes the improvement of our rivers subordinate entirely to the raising of revenue, while the facilities of commerce and the promotion of national well-being are made the merest incidents of the taxing power? Instead of raising revenue for purposes of general beneficence, we tolerate such purposes as incidental to the raising of revenue. I protest.

“ ‘But may the Government make a harbor at Chicago?’ Mr. F. was asked. ‘Was there any harbor here already?’ he queried in turn. Here is Mr. Wright’s distinction again. But just consider it for a moment. Suppose there had been originally a dozen perfect harbors on the southern coast of Lake Michigan, with half a dozen needing some work to render them safe and accessible, these latter being needed only for local accommodation, might not their improvement have been fairly deferred to local and personal enterprise, on the ground asserted by Colonel Benton that they in truth ‘harbored nothing but the interest of their owners?’ Now take the actual case of the entire coasts of Lake Michigan, nine hundred miles in extent and covered with commerce, yet without a single harbor or place of refuge for vessels in a storm, who can doubt that the construction of one or more harbors is imperatively demanded by considerations of national and general well being? No matter if they have to be made entirely,—scooped out of the shifting

sands and fortified by expensive piers,—the very fact that they must be expensive puts them beyond the reach of private enterprise or local exertion. The greater the natural deficiency,—the necessity of harbors being obvious and conceded,—the more palpable the necessity, and thus the constitutionality of national interposition.”

Although this remarkable convention was called specifically for the purpose of furthering the interests of harbors and navigable rivers, its thought could not be disassociated from the paramount advantages of a waterway communication between Lake Michigan and the Mississippi river. The Government had already aided the Illinois and Michigan canal, then nearing completion, and there was no word of protest from the strict constructionists. Discussion did not dwell upon the canal, because there was then no indication that its capacity was not sufficient for the commercial needs of the future. But the influence of the convention has strengthened the sentiment that an adequate waterway through the Desplaines and Illinois valleys is of national importance.

Thurlow Weed was strongly impressed with the future of Chicago. He wrote to his paper: “Chicago is destined to be a large and beautiful city. It is regularly laid out, with its broad avenues, and out of the business part of the city it is thickly planted with trees which will soon, in addition to adorning the city, furnish a grateful shade. It has four admirably conducted schools, much larger than ours and filled with children. The various religious denominations have large houses of public worship. The river extending well through the city furnishes an ample and excellent harbor. All are looking forward anxiously to the completion of the canal. That done, Chicago will eclipse even its own past magic-like growth. In ten years Chicago will contain more inhabitants than Albany.”

The Chicago river and harbor convention was prompted by the unsatisfactory results of the Memphis convention

held in November, 1845. The object of the latter convention was "to confer on the measures which should be adopted for the development of the resources of the valley of the Mississippi and the adjacent States on the Gulf of Mexico and the Atlantic coast." Nearly six hundred delegates were in attendance. Sixteen States and one territory were represented. John C. Calhoun presided. The deliberations of the convention, in the main, were directed to the development of the Mississippi as far north as Memphis into an arm of the sea, and to the construction of a railroad to connect the Mississippi or the Gulf with the Atlantic States.

Although Calhoun was firmly opposed to internal improvements at the expense of the General Government, unless three or more States were benefited, he thought there were occasions when the principle might be made elastic. He is reported as saying in his opening address that "it was the genius of our Government, and what to him was its beautiful feature, that what individual enterprise could effect alone was to be left to individual enterprise; what a State and individuals could achieve together was to be left to the joint action of States and individuals; but what neither of these separately or conjointly were able to accomplish, that and that only was the province of the Federal Government."

Mr. Calhoun favored a grant of land to aid the construction of a railroad between the Mississippi river and the southern Atlantic States because other public lands would be benefited thereby, and the National Government could not be expected to refuse to do what would result in its own benefit. "It would neither be just nor fair," he said in a report drawn by him and presented to the United States Senate, "for it to stand by and realize the advantage they would derive from the work without contributing a due proportion towards its construction. It would be still less justifiable to refuse to contribute if its effects should be to

defeat a work the construction of which, while it would enhance the value of the land belonging to the public and that of individual proprietors, would promote the prosperity of the country generally."

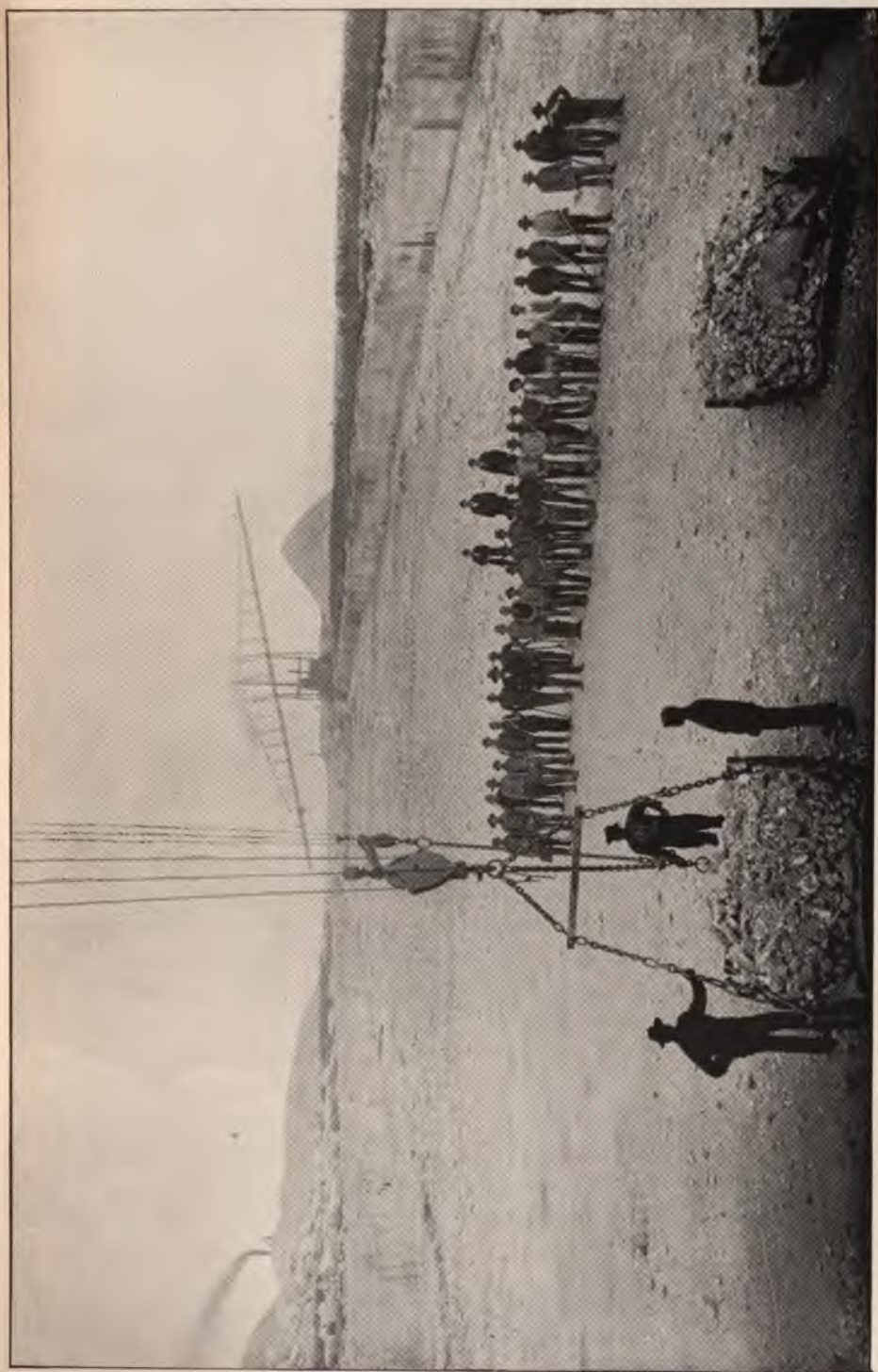
Scant recognition was given the advantages which might result from an improved communication between the Mississippi and the Great Lakes. Of twenty resolutions adopted the following brief one alone referred to it: "That the project of connecting the Mississippi river with the lakes of the north by a ship canal, and thus with the Atlantic ocean, is a measure worthy of the enlightened consideration of Congress."

A committee was appointed by the convention to draft a memorial to Congress. In this memorial it was conceded that a connection of the northern lakes with the Mississippi and the Atlantic by a ship canal was among the objects not within the jurisdiction of a single State to control, but common in its benefits to the whole Union and within the powers of the General Government. But the benefits which warranted the consideration of Congress were military and not commercial. "As a mere speculative improvement within the limits of a single State, simply to open a new channel between other natural outlets of commerce, this project," the committee said, "could claim, probably, no action from your honorable body. As a ship canal (if practicable) connecting the northern lakes of the Mississippi with the Gulf of Mexico it may, however, under the powers of the General Government to provide for the general defense, merit 'the enlightened consideration of Congress.' The frontiers of the lakes and Gulf are now disconnected. They are in opposite directions and the extreme points of the Union, and the naval forces intended for the defense of either must be local, prepared for that specific object. By no means could they now be made to combine or coöperate together. If the Mississippi, how-

ever, could be made navigable at all seasons for war steamers, and a communication of like capacity could be opened between that river and northern lakes, it must be apparent to your honorable body that the project might be made to contribute most essentially to the security of the country in time of war, not merely in the great despatch secured, but in the greater economy in the application of the means to the end. It would enable our fleets to circumnavigate three-quarters of the circle of the Union. It would enable one fleet to act on two frontiers, or two fleets to combine and coöperate, whether in the Gulf or the lakes, wherever danger called. The practicability of the project established by scientific examination and survey, and its policy, as a means of protection, would merit grave consideration."

The report of the Senate committee to whom this memorial was referred was written by Mr. Calhoun. In it occurs this clause: "In reference to that portion of the memorial which relates to the connection of the Mississippi and the lakes by a canal which would admit ships of the largest class navigating either to pass from one to the other, your committee fully concur in all which it states in reference to its importance; but they are of the opinion that Congress has no power under the Constitution to construct such a work. It stands, in that respect, on the same ground with railroads and other works of internal improvement; and like them it may be aided directly by Congress should it pass through the public domain, by the grant of alternate sections, but no further."

Congress took no action on the memorial.



CHAPTER XVI.

SHIP CANAL BEFORE CONGRESS.

Encouraged by the universal sentiment in favor of a serviceable waterway between the lakes and the Mississippi, exhibited at the convention of 1847, its advocates were persistent in their claims. The Illinois and Michigan canal, completed in the following year, proved its usefulness commercially, until the diminishing depth of the Illinois river reduced the traffic between La Salle and the Mississippi. The United States Government was then urged with increased vigor to construct a ship canal from lake to river, with a capacity sufficient to meet the demands.

Appeals in the interest of commerce fell upon deaf ears. It was not until the War of the Rebellion was in progress, and the military advantages of a canal large enough to pass gunboats and transports with supplies became apparent, that Congress consented to listen. The blockade of the Mississippi placed the North at a disadvantage in its valley operations, and there was a constant fear that Great Britain would become the ally of the South. In the latter event, it was argued, a fleet could be sent into the Great Lakes within sixty days that would place every city on their coasts at the mercy of the enemy, and open up a communication to every stronghold of the North. It was hardly expected that an enlarged canal could be constructed soon enough to be of use in the existing war, but the lesson to be learned from the possibilities was not to be overlooked.

A bill was introduced in the House of Representatives early in 1862, providing for the construction of a serviceable

waterway, and was before that body nearly a year. There was no measure, even in those exciting times, that received closer attention and provoked more bitter animosities than this. Days and weeks were spent in its discussion. It failed at last to pass the House by a narrow majority of ten, the vote standing 61 to 71. The defeat of the bill was brought about chiefly by the jealous opposition of Indiana and Ohio, whose representatives insisted that its military features were only a cloak, and that its real purpose was to benefit a single State at the expense of the whole country.

The bill originated with the committee on military affairs. It authorized the construction of a ship canal for the passage of armed and naval vessels from the Mississippi river to Lake Michigan, and for other purposes. It was introduced by Mr. Blair of Missouri on February 20, 1862. The bill was read twice, ordered printed and recommitted to the committee on military affairs. It was reported back by this committee on June 13, with amendments which provided for the improvement of eastern canals. As amended, the bill contained the following provisions:

1. As soon as the State of Illinois shall transfer to and vest in the United States a clear and unencumbered title to the Illinois and Michigan canal, William H. Swift, one of the Canal Trustees, with an engineer in the topographical corps of the United States army, to be designated by the secretary of war, and a citizen of the State of Illinois to be designated by the President of the United States, shall be commissioned with authority, under the direction of the secretary of war, to enlarge the Illinois and Michigan canal, and to improve the navigation of the Illinois and Desplaines rivers in such a manner as to furnish a suitable and sufficient water communication for the gunboats and other naval and war vessels of the United States between Lake Michigan and the Mississippi river.

2. The Commissioners shall forthwith make a careful

examination and survey of the canal and river, and determine upon a suitable plan for the improvement of the canal, which shall be not less than 160 feet wide, with locks not less than 350 feet in length and 75 feet in width, and for the improvement of the Illinois river in such a manner as to insure a safe and uninterrupted water navigation between Lake Michigan and the Mississippi river at all times during the season of navigation of gunboats, steamboats, naval and war vessels of the United States, and all other vessels not drawing over six feet of water.

3. On approval of the plans by the President the Commission shall proceed with the execution of the work with such dispatch as the nature of the work and the funds appropriated by Congress will permit.

4. Under the direction of the secretary of the treasury the Commission shall have exclusive control of the canal and condemn all lands needed, under the laws of the State of Illinois, the work to be done by the lowest responsible bidder at public lettings.

5. The revenues above necessary expenses shall be paid into the United States treasury, to be appropriated, first, to the payment of the interest and principal expended by the United States ; and, second, to the payment to the State of Illinois of the entire amount which was a charge upon the canal at the time of the conveyance to the United States, with interest.

6. Each of the Commissioners shall receive a salary not exceeding \$6,000 per annum.

7. After reimbursement to the United States of the amount expended by them and to the State of Illinois of the canal indebtedness, it shall be the duty of the President of the United States, upon the request of the Legislature of the State of Illinois, to transfer to the State of Illinois the Illinois and Michigan canal, with a proviso to be attached that the canal shall forever after be open and free to navi-

gation by all citizens of the United States, subject only to such tolls as shall be necessary to keep the canal in suitable repair and defray the current expenses of management, and subject to the further condition that the United States shall have the right at all times to transport vessels of war, troops and public property over the canal absolutely free from any toll or other charge.

8. The Government of the United States will, as soon as the State of Illinois shall have transferred the canal, apply the sum of \$13,346,824 in bonds of the United States, redeemable in twenty years from date, bearing interest at the rate of 6 per cent, payable semi-annually, to the construction of the work, the interest to be payable and the bonds redeemable out of moneys to be appropriated by Congress, principal and interest to be reimbursable from the tolls and revenue of the canal, and the secretary of the treasury may pledge the net tolls and revenues for the payment of the principal and interest of the bonds.

9. The bonds shall be delivered to the Commissioners on demand, and \$20,000 shall be advanced for preliminary expenses.

10. Enlargement of the locks of the Erie and Oswego canals to a capacity sufficient to pass vessels of war at least 25 feet wide and 200 feet long is authorized, the Government of the United States to apply the sum of \$3,500,000 to the work in bonds bearing 6 per cent interest and redeemable in twenty years.

11. Bonds for the enlargement of the Illinois and Michigan canal and the improvement of the Desplaines and Illinois rivers shall be delivered upon condition that the State of Illinois shall pay the excess which the improvements cost over \$13,346,824. A similar provision is made in the case of the New York canals.

Mr. Blair advanced the argument that the Illinois and Michigan canal was a measure of national defense. He

referred to the commercial success of the Erie canal, and said he believed the enlarged Illinois and Michigan canal would pay the interest on \$10,000,000 and wipe out the principal in a very few years.

Mr. Arnold of Illinois asked the attention of the House "to the most important work in a national point of view ever presented to the consideration of Congress." "It is no experiment," he said, "which Congress is asked to make. The plan is based upon no untried theory, but is embodied in a simple proposition of the State of Illinois asking the National Government to aid with her credit so far and so fast as the tolls of the canal will meet the accruing interest." The speaker read a resolution passed by the constitutional convention of the State of Illinois held at Springfield, March 17, 1862, which said: "The improvement contemplated would not only be of great utility to the State of Illinois, but of paramount importance in time of war, either foreign or domestic, to the defense and preservation of the Union, and this State will coöperate with the General Government in any plan for its speedy construction."

Mr. Arnold also read from the report of the select committee on the defense of the lakes and great rivers. "The realization of the grand idea of a ship canal from Lake Michigan to the Mississippi, for military and commercial purposes, is the great work of the age. In effect commercially, it turns the Mississippi into Lake Michigan, and makes an outlet for the Great Lakes at New Orleans, and of the Mississippi at New York. It brings together the two great systems of water communication of our country,—the Great Lakes and the St. Lawrence, and the canals connecting the lakes with the ocean on the East, and the Mississippi and Missouri with all their tributaries on the West and South. This communication, so vast, can be effected at small expense, and with no long delay. It is but carrying out the plan of Nature. A great river, rivalling the St.

Lawrence at no distant day, was discharged from Lake Michigan by the Illinois into the Mississippi. Its banks, its currents, its islands and deposits can still be easily traced, and it only needs a deepening of the present channel for a few miles to reopen a magnificent river from Lake Michigan to the Mississippi." The report further stated that had the ship canal been opened, its cost would have been nearly saved during the previous year in the expenses of the expeditions on the Mississippi.

Mr. Arnold said the only objection which had been urged against the work, was that of a supposed draft upon an already overburdened treasury. This objection had been carefully considered by the committee, which believed that the interest on the cost of the canal would be promptly paid by the tolls, and that such tolls would provide a sinking fund which would at an early day discharge the principal. Thus this great national work, free always for the military purposes of the Government, having paid for itself, would become free to the vast and constantly increasing commerce of the lakes and the Mississippi. It would save to the Northwest every year, in lessening the cost of transportation of its staples, more than its entire cost. It would, the day it was completed, add to the taxable property of the nation an amount the taxes upon which would more than pay the interest upon its cost.

The Northwestern States embraced one-half the loyal people of the Union. While Congress had appropriated at the present session nearly \$50,000,000 for forts, ships, etc., on the Atlantic, not \$1,000,000 had been given to the Northwest. The great naval depots, shipyards, arsenals, and armories at the East, had received large appropriations, but there was no depot, armory, shipyard, nor foundry on all the northern lakes. Mr. Arnold read from a statement of the secretary of the treasury, the amounts of money expended by the Government from the adoption of the con-

stitution to June 30, 1860, in each State and Territory for navy yards, custom houses, court houses and other public buildings, for the improvement of rivers and harbors, etc. Out of a total of \$111,773,986, Illinois, the fourth State in the Union, had received less than \$1,000,000. Mr. Arnold appealed to the justness and the fairness of the eastern States. "We ask nothing for our immediate local advantage," he said, "but when we ask aid for a work so national, so necessary to national defense and security, so beneficial to every section, I trust we shall not ask in vain." He insisted there was not a place on earth where the same amount of money would accomplish such vast commercial results.

Quoting from the reports of the Erie canal, Mr. Arnold added: "Looking at these and other statistics, no sensible man will doubt but this Illinois canal will in a short time pay for itself, and become, as it ought to be, free as the great waters it will unite. Thirty-six miles of cutting, already more than half done, is the only obstacle to letting a Niagara of waters from the lakes into the Mississippi, a Niagara of trade from the valley of the Mississippi to the Atlantic. The military necessities of the country and the wants of commerce alike demand that this work be done. These are too strong to be resisted. He who stands in the path of these improvements, to hinder or delay them, will be swept away."

Mr. Pomeroy of New York said it was never designed that the almost boundless cereal productions of the Northwest should be borne to market through the torrid heat of the Mexican gulf and the Middle ocean. Were that the only outlet, a hundred million bushels of growing corn would be shut out from market, and become worthless except for fuel. The course of the Great Lakes, commencing within a few miles of the head waters of the Mississippi, and stretching with their rivers easterly through the Gulf of St. Lawrence,

completed the want, without which the rich granary of the Northwest would but mock the hunger of the world. It was a happy circumstance that the expenditure provided for by the bill, while furnishing the most economical means possible for defense, was also the most judicious means of development of the material resources of the country.

Mr. Van Horn of New York pleaded for the freedom of the Mississippi, one great outlet for both sections of the country. To draw a line between the North and the South, the East and the West, and compel communication and intercourse to cease, would dry up the fountains of the country's prosperity, and turn back the overflowing tide of progress.

Mr. Stevens of Pennsylvania attacked the bill by ridicule. He offered an amendment providing for an appropriation of \$1,000,000 to slackwater the Susquehanna river from its mouth to its source in New York, and for constructing a ship canal from the latter point to Lake Erie at or near Buffalo. "I offer that amendment," he said, "for the purpose of showing that we are not selfish; that we are willing to take our full share of the many millions which these internal improvements will cost. But, Sir, to say nothing of that, I believe this the most feasible scheme that has been offered. The Susquehanna river has water in it, whereas the Illinois river has sometimes only, and I have great fear that if you open communication to it from the lake to furnish water for the river you will drain the lake and find nothing but dry land." The cost might be \$200,000,000, but that would be nothing, judging by the speeches made. He did not expect the bill would receive so many votes as there had been speeches made favoring it. But an election was close at hand, and the measure might be useful in navigating shoals. It would take years to complete the Illinois canal, and cost millions upon millions of dollars.

The bill was laid on the table in July, but was taken up again in January, 1863. From this time until its defeat it

was before the House almost continually. It was first amended by providing that the appropriation by the National Government should not exceed \$10,000,000. William S. Holman of Indiana, who has since earned the title of "Objector," was a vigorous opponent of the bill, attacking it on technical grounds. His first point was that, because of the amendment, the bill was not the same as the one which had been pending, and, since it appropriated money, it must be first considered in the committee of the whole on the state of the Union.

"My young and aspiring friend is mistaken upon both points," said Mr. Olin of New York. The speaker overruled the gentleman from Indiana, and the discussion was continued. But the filibustering was resumed by Mr. Holman, who was aided by Mr. Stevens of Pennsylvania, and a vote on the bill was delayed. Said Mr. Kellogg of Illinois on February 4: "The experience of more than a week past has shown that all parliamentary power and tactics which are accessible to gentlemen upon this floor will be brought to bear to prevent a vote upon and to defeat this bill. I have no objection to a fair discussion of or action upon this bill. But when it is met at every possible step by all the machinery, large and small, by all power, official and otherwise, to defeat it, I, for one, am disposed to try the strength of the measure by putting it upon its passage. I desire that to-morrow or next day at one o'clock a vote shall be taken, and then, if it is killed, let it be killed; if it dies for want of votes let it go down; but in God's name do not strangle it or let it go by indirection."

Mr. Voorhees of Indiana opposed the bill on the ground that the canal would cost untold millions of dollars, and that it would be useless, unless the channel of the Mississippi was also deepened, to admit boats of the size of those expected to reach the mouth of the Illinois. He desired to know whether it was not a fact that the Missis-

ssippi, from the Illinois to St. Louis, was navigable only for the smallest boats for the greater portion of the year, and whether the improvement of the navigation of that river was at all practicable. "I may say," he added, "so far as I have any right to speak for any portion of the Great West, that we, for the present at least, in our present condition of finance, are satisfied with the channels of communication which the Almighty has created for us. We shall be satisfied to be in possession of the channel of the Mississippi river. It is better than any of your canals. You cannot compete with what the Almighty has done in that valley. And you cannot turn back the course of trade. You can no more turn back the current of trade of that broad and fertile agricultural region against its natural tendencies to the Gulf of Mexico, than you can turn the waters of its great river backward toward its source." He referred contemptuously to the proposed ditch across the State of Illinois, and declared that the bill was framed merely for the benefit of a local interest at the expense of the entire body politic.

Mr. Holman declared that Illinois and New York would profit at the expense of their sister States and of the public credit, and that, too, on the miserable pretense of providing for the national defense. "When gentlemen propose to reconcile the Northwest to an abandonment of its great natural thoroughfare by creating these artificial channels of communication, they misapprehend the spirit and temper of the entire valley of the Mississippi," he said.

Mr. Porter of Indiana said the bill aimed a blow at the State which he in part represented and others of the Western States.

Before the conclusion of the debate, Mr. Washburne of Illinois, one of the most vigorous of the bill's defenders, was prompted to say: "The hostility which has been developed in this hall to this great national and military project, and

to the interests of the great Northwest, is of the most extraordinary character that I have ever witnessed during my term of service in Congress."

To aid in the defeat of the bill, resolutions were hastily passed by the State Legislatures of Ohio and Indiana condemning it. These were promptly read in Congress. The only members from Indiana who voted for the bill, were Colfax, White and Julian. The Ohio members voting in its favor were limited to Ashley and Riddle. The *Chicago Tribune's* Washington correspondent telegraphed that paper on the day of the final vote: "The feeling over the defeat of the bill was unusually bitter. Washburne was particularly conspicuous in declaring that Congress had voted to smother the Northwest and might as well adjourn; that the country had received a vital stab by to-day's action."

The *New York Times*, in reviewing the proceedings of the final day, and commending the action of the advocates of the bill, said: "All efforts, however, proved unavailing against the defection of a part of New York and the hostility and tactics of Pennsylvania. The disastrous change in the Ohio and Indiana votes had been skillfully effected by resolutions lately hurried through the Ohio Legislature on the exaggerated misrepresentations of Mr. F. A. Conkling, as to the fabulous cost of the proposed work, and which Mr. Olin, on the floor of the House, stigmatized as a tissue of falsehoods. The unfriendly feeling of the members representing the Ohio river districts, was stimulated by jealousies of the immense and rapidly increasing commerce which Chicago would enjoy by reason of the proposed canal through Illinois, connecting Lake Michigan with the Mississippi. The stream of trade, the life blood of the Erie canal revenues, may soon be exposed to serious hazard as the Illinois Legislature, under this sectional rebuff, will without delay apply to Canada to construct the Ottawa ship canal, twelve feet in depth, leading directly from Lake

Michigan to Montreal, nearly five hundred miles in distance, and wholly avoiding New York and its canals. New York has little reason to thank six of her recusant members on whom directly falls the responsibility of defeating this great national measure for cheaply connecting the Mississippi with the Hudson."

The bill came to a final vote and was lost on February 9, 1863. Mr. Arnold secured the privilege from the committee on roads and canals to report the bill again, without the Erie and Oswego canals amendment, but nothing further was ever heard of it.

On April 16, 1878, a bill for the construction of a ship canal was introduced in the House by Carter H. Harrison of Chicago, but it failed to get beyond second reading.

CHAPTER XVII.

DEEPENING OF THE ILLINOIS AND MICHIGAN CANAL.

During the early part of the year 1863, while the bill providing for a ship canal in the Illinois valley was pending in Congress, the people of Chicago were earnestly discussing the proposition to deepen the Illinois and Michigan canal. At a meeting of citizens, Colonel J. W. Foster, George F. Rumsey, Charles Walker, William McKindley, R. McChesney, William Bross and John B. Preston were appointed a committee to collect statistics to prove the importance of uniting the waters of the Mississippi and the Atlantic by a ship canal. William Gooding and John B. Preston were detailed to collect the facts relating to the old canal with which they were familiar. Their report was made on May 30. It was based on a new survey made under their supervision by A. J. Mathewson. The estimate of the cost of a canal not less than 160 feet wide at the top, where an artificial channel was necessary, and an improvement of the Illinois river which would admit of the passage throughout of boats drawing not less than six feet of water, was \$13,446,625. The channel proposed was not a ship canal as the term was generally understood, since it would not be navigable for ships, but only for the largest steamboats which could ascend the Mississippi at ordinary low water to St. Louis. The locks were to be 350 feet long and 75 feet wide, large enough to pass twelve ordinary canal boats at one lockage. It was assumed that a gunboat 200 feet long, 40 feet wide, and drawing 10 feet of water, if buoyed up by barges or lighters, could pass through the channel from one end to the other without difficulty.

It was proposed to enlarge the Illinois and Michigan canal from the Chicago river to the lower dam at Joliet, a distance of $33\frac{1}{2}$ miles, to a width of 160 feet at the surface, and deepen it upon the Summit to the original level adopted by the Canal Commissioners in 1836. With a little additional excavation in the bottom of the channel for the first ten miles out of Chicago, boats with six feet draft could navigate the canal at the minimum stage of water in Lake Michigan.

The most expensive part of the work would be that between Chicago and Joliet. Throughout this division the new channel would follow the line of the old canal. Below Joliet the old canal, except for the five or six miles between Marseilles and Ottawa, would be abandoned, and the Desplaines and Illinois rivers improved by locks and dams.

"The first $8\frac{1}{2}$ miles from Chicago river," said the engineers, "the material to be excavated is a compact clay, all of which can be easily excavated by machinery. This has been estimated at 25 cents per cubic yard.

"For the next $10\frac{1}{4}$ miles the excavation will be of a much more difficult character, though still mostly in earth, but a considerable proportion of it cemented clay intermixed with small stone or gravel. It is believed, however, that the greater part of it may be excavated by machinery, though with less facility than the first $8\frac{1}{2}$ miles. On a few of the sections embodied rock was found in the old excavations. This part of the work is estimated at 50 cents per cubic yard including all the various kinds of material.

"From the Sag, where the heavy rock excavations commence, to Lockport, a distance of $10\frac{1}{4}$ miles, the excavation, except a slight covering of earth about two feet in depth, consists entirely of stratified lime rock. For some eight miles of this distance the depth of rock varies from twelve to sixteen feet.

"All of the excavation on this part of the line was com-

pleted on the original plan of the 'deep cut,' except about 260,000 cubic yards, so that it only requires this amount to be excavated to make a perfect drainage to the bottom of the enlarged canal, and give a fall the full depth of the excavation for the entire distance. Considering the character of the rock and the favorable circumstances for executing the work (permitting the use of machinery propelled by steam for drilling and removing it), we have deemed 90 cents per cubic yard a liberal price, and have estimated it at that price.

"We mention particularly the character of the material to be excavated on this part of the work, and the prices at which we have estimated it, because its cost will be more than half the entire improvement. But this cut through the Summit, though expensive, accomplishes a very important object. It diverts the waters of Lake Michigan into the valley of the Desplaines at Lockport through a canal 160 feet wide at the surface, and not less than $7\frac{1}{2}$ feet deep in an ordinary stage of the lake. A declivity of one inch per mile at the very lowest stage of Lake Michigan has been given on this 29 miles of canal in the estimates.

"From Lockport, where the Lake level runs out to the lower dam on the present canal at Joliet, the distance is $4\frac{1}{2}$ miles and the lockage 50 feet.

"The whole amount of lockage from the point where we leave the present canal at Joliet to La Salle is 88 feet, and from thence to the mouth of the Illinois river 32 feet, making the aggregate lockage from Lake Michigan to the Mississippi 170 feet. The whole distance is 320 miles. To overcome this difference of level we have estimated in all, above La Salle, fourteen lift locks, the lifts varying from eight to twelve feet each. But one guard lock is required. All but three of the nine locks below Joliet will be built upon short sections of canal, and entirely secure from river floods.

"Only five dams have been found necessary between Joliet and La Salle, two of them on the Desplaines river and three on the Illinois. The two on the Desplaines have been estimated entirely of stone, and the three on the Illinois of crib work resting on timber foundations with stone abutments, being of the same character in all respects as those which were estimated for the Illinois river improvement below La Salle."

The estimates were made on work to be constructed in the most substantial manner; nothing was added for show. The stone masonry in locks, dams and bridges was to be constructed of rock work, with a face sufficiently smooth for practical purposes only. The stone in the quarries along the line was thought to be well adapted to this kind of work, being regularly stratified, the beds parallel, and generally so smooth as to require little dressing.

The following recapitulation shows the estimated cost for the channel throughout the 320 miles:

Bridgeport to Lockport, Summit line.....	29	miles	\$7,299,742 00
Lockport to Dam No. 2, 50 feet lockage.....	4.5	"	876,323 60
Dam No. 2 to Lake Joliet, 24 feet lockage.....	3.5	"	500,085 30
Lake Joliet to La Salle, 64 feet lockage.....	59	"	2,198,932 10
La Salle to Mississippi River, 32 feet lockage.....	220	"	1,644,335 00
Bridges, Culverts and Land Damages.....			325,000 00
Engineering and Contingencies.....			602,207 00
Total.....			\$13,446,625 00

The engineers concluded their report by calling attention to some of the obvious advantages of the enlarged channel. They were as follows :

1. It would extend a navigation for first-class river steamers from the Gulf of Mexico to within one hundred miles of Lake Michigan at Chicago.
2. In connection with the Illinois and Michigan canal it would form the only cheap and direct navigable communication between the Mississippi river and the great lakes.
3. It would so diminish the cost of transportation by the

northern route to the seaboard and all intermediate points that the increase of business would be immense.

4. The extensive water power which would be created upon the Illinois and Michigan canal when the Summit should be cut down so as to draw a supply of water directly from Lake Michigan, would attract a large commerce from the lower Mississippi, which would otherwise never seek the northern route.

5. By the mutual interests created by the construction of the proposed improvement, the North and the South, the East and the West would be more firmly bound together, and there would be less danger from sectional prejudices and adverse interests.

The committee on statistics in turn prepared an exhaustive report based on the facts collected by Messrs. Gooding and Preston. Their report was published in June, 1863. Reference was made to the bill which had failed of passage in Congress, and the fact was regretted. There followed a detailed description of the Mississippi basin and a reference to the fact that the commerce of the great lakes, the annual value of which was \$450,000,000, was more than twice that of the ocean commerce of the whole country. The committee maintained that the commerce which floated upon a river like the Mississippi, which drained half a continent, or upon the great lakes, whose shore lines were longer than those of the seaboard states, or was poured through an artificial channel like the New York canal, was as much national as that which belonged to the Atlantic.

When it was known that eight-ninths of the cereals of the country were derived not from a single State, but from a group of States, and were moving not to a local market, but to the markets of the world, furnishing to navigating interests the outward-bound freight as well as the return cargo conferring a direct benefit on the national finances; and when the proceeds of these products were traced through

all the ramifications of trade, it was evident that not merely the citizens of one State, but the western producer, the consumer at home and abroad, the navigator, the importer, the consumer of foreign fabrics, and the Government itself, all had a direct interest in the result. The proposed improvement was a measure whose benefits were not to be circumscribed by State lines, but one which connected three distinct systems of navigation and rendered them available for external and internal commerce, for national unity and military defense.

If it were asked why the State of Illinois did not execute the work or confide its execution to a chartered company, the committee would say that the State could not enter upon the work without changing her organic laws. While she was agreed on the policy of surrendering the route to the General Government to be used as a national highway, it was doubtful whether a like unanimity would prevail with regard to the State's taking such action, even if constitutional impediments were not in the way. The State, through her constitutional convention, had indicated her policy in no event to surrender the work to a chartered company.

In conclusion, the committee stated that the enterprise was one which, in whatever light it was viewed, ought to commend itself to the favorable consideration of the country. In its lowest sense, as a mere pecuniary investment, the bonds of the United States, based on the tolls of the canal, would command the confidence of capitalists. As a commercial scheme it would enhance the value of the public lands and communicate a stimulus to agriculture which would be felt to the verge of civilization. It would cheapen the price of daily food and swell to a vast extent foreign commerce. As a national measure it would establish between the East and the West closer commercial and political affiliations and forge a chain which no convulsion could sever. As a military system it would be the cheapest method of

fortifying a line of frontier and of controlling an immense navigation.

Two days after the publication of the report of the committee the great ship canal convention of 1863 was held in Chicago. The earnest discussion which ensued and which had been prompted in part by the failure of the bill in Congress in February, 1863, resulted in a meeting of a joint committee representing the Board of Trade and the Common Council appointed to consider the urgent necessity of a western outlet for the Chicago river. The question had now become one of sanitation rather than commerce. At this meeting resolutions were passed requesting the Common Council to apply to the Legislature for authority to borrow a sum of money not to exceed \$2,000,000; that the Common Council or the Board of Public Works be requested to ascertain by survey the practicability and the cost of draining the Chicago river by way of Mud lake to and along the Desplaines river; that the Common Council or the Board of Public Works be requested to ascertain the cost of cutting a channel or ordinary canal from the South Branch of the Chicago river to the lake near the city limits with a sufficient capacity for cleansing the river; that the Common Council be requested to provide for the appointment of Commissioners consisting of three or more able and experienced civil engineers to consult with the city engineer and report upon the best plan for cleansing the Chicago river.

These resolutions were presented to the Common Council on January 9, and adopted, and William Gooding, R. B. Mason, John VanNortwick, E. B. Talcott and E. S. Cheshbrough were appointed a committee to fulfill the requirements of the resolutions. The report of this committee, dated March 6, 1865, is given in full in Chapter VI.

At a previous meeting of citizens a committee of thirty was appointed to devise measures for the permanent purifica-

tion of the Chicago river and its branches. This committee met on January 6, and appointed a sub-committee of three to urge upon the city authorities the necessity of having an immediate survey of the Desplaines river made from the point where the Mud lake ditch entered it, the excavation of which would create a current that would drain the South branch of the Chicago river.

About the same time another faction of citizens met and endorsed a plan for draining the South branch of the river by pumping its water into a canal 100 feet wide, 15 to 25 feet deep and ten miles long, terminating at the Calumet river. They also reported a bill for an Act of the General Assembly, entitled, "An Act to Incorporate the Chicago River Commission." Resolutions were passed by the Common Council on January 20, condemning the scheme proposed, the cost of which was estimated to be \$3,000,000. Nothing further was heard of it.

The agitation for an improvement of the Chicago river resulted in the Act of the State Legislature of February 16, 1865, providing for the completion of the Illinois and Michigan canal upon the plan adopted by the State in 1836. Contracts for the deepening of the canal across the Summit level were awarded in September, 1865. Fox, Howard & Walker were allotted sections 1 to 44 inclusive, terminating near the Sag, at 33 cents per cubic yard for earth excavation and \$2 for rock. Sections 45 to 64 inclusive, approximately from the Sag to Lockport, were awarded to Sanger, Steele & Co., rock exclusively, at \$1.64 $\frac{3}{4}$ per cubic yard. Both firms appear to have been unable to execute their contracts at the prices agreed upon, and there were repeated and prolonged delays. In the second year Fox, Howard & Walker agreed to pay \$50,000, the amount of their bond, if released from their contract. Among their other difficulties they had encountered the cemented clay to which Engineers Gooding and Preston referred in their report to

the committee on statistics and which defied the prevailing methods of excavation. The offer was not accepted, but the contractors finally abandoned work on sections 17 to 37. New bids were received for the work on these sections on December 3, 1886, the specifications reading "for all excavation except embodied rock," and "for embodied rock." The new bids ranged from 50 cents to \$1.50 for the work under the former classification, and from \$2 to \$3.50 under the latter. The bids were considered too high and none were accepted. On March 4, 1867, the contracts with Sanger, Steele & Co. were declared forfeited, and two days later the remainder of those held by Fox, Howard & Walker.

For the purpose of making a test the Board of Public Works employed one of the dredging machines belonging to the contractors until new bids were opened on May 1, 1867, covering the entire Summit division. The offers ranged from 23 cents to \$2 for all excavation except embodied rock, and from \$1.70 to \$4 for embodied rock. Again no contracts were awarded, but on August 17, when bids were received a fourth time on sections 1 to 16, sections 1 to 13 were awarded to Fox, Howard & Walker at 55 cents, and sections 14 to 16 to Hirsch & Haroun at the same price. There were six subsequent lettings on the remaining sections at each of which the prices crept up to higher notches. There were several forfeitures of contracts, but the Board of Public Works virtually admitted that the work could not be done at the prices accepted by allowing Fox, Howard & Walker 90 cents a cubic yard during one of the intervals. When all the contracts were finally let the prices ranged from 55 cents to \$1.50 for earth excavation and \$1.85 to \$4.50 for rock, an increase of 70 to 500 per cent in the earth prices and 12½ to 175 per cent in the rock prices.

By the terms of the original contracts the work of deepening was to have been completed in 1868, but the Trustees

of the canal consented to an extension of the time for three years. The records of the Board of Public Works are filled with urgent demands upon the contractors and threats of annulling contracts. Fox, Howard & Walker, and some of the other contractors, were ordered several times to provide more and better machinery. The former were once directed to procure powerful steam dredges, one of which must be of the strongest construction. "It may be found," the order added, "that no dredge which can be built will successfully excavate the very hard material on portions of sections 40 and 41 and on some of the other sections between the Summit and the Sag." Money was advanced by the city to contractors for the purchase of machinery, chattel mortgages being received as security.

The total amount expended for construction from the beginning of the canal in 1836 until the deepening was completed in 1871 was as follows :

1836 to 1842, By the State	\$5,139,492 03
1843 to 1848, By the Trustees	1,429,606 21
1866 to 1871, By the City of Chicago	<u>3,800,883 71</u>
Total	\$9,869,981 95

The following table shows the annual cost of the ordinary repairs, extraordinary repairs, renewals and hydraulic works, the gross expenses and the tolls of the Illinois and Michigan canal from the date of its opening in 1848 to 1892 inclusive :

Year.	Ordinary repairs.	Extra-ordinary repairs, renewals and hydraulic works.	Gross expenses.	Tolls.
1848.....	\$36,452	\$ 6,744	\$43,197	\$ 87,890
1849.....	43,922	26,999	70,922	118,375
1850.....	38,418	19,996	58,415	125,504
1851.....	39,447	19,027	58,475	173,300
1852.....	42,816	10,692	53,508	168,577
1853.....	40,383	4,486	44,870	173,372
1854.....	36,587	16,654	53,242	198,326
1855.....	38,216	32,657	70,873	180,519
1856.....	33,101	58,357	91,458	184,310
1857.....	37,256	65,825	103,082	197,830
1858.....	36,115	21,972	58,088	197,171
1859.....	34,026	40,406	74,432	132,140
1860.....	34,308	48,275	82,583	138,554
1861.....	39,238	15,823	55,061	218,040
1862.....	40,024	15,337	55,362	264,657
1863.....	49,294	13,021	62,715	210,386
1864.....	47,535	18,572	66,107	156,607
1865.....	39,255	85,614	124,869	300,810
1866.....	43,716	72,647	116,363	302,958
1867.....	46,152	116,504	162,656	252,231
1868.....	52,984	69,067	122,052	215,720
1869.....	49,514	42,251	91,765	238,759
1870.....	43,098	65,597	108,695	149,635
1871.....	54,555	42,667	97,222	159,050
1872.....	42,785	46,091	88,876	165,874
1873.....	53,525	27,573	81,098	166,641
1874.....	49,139	24,659	73,798	144,831
1875.....	46,241	28,270	74,511	107,081
1876.....	42,418	49,167	91,585	113,293
1877.....	54,965	55,053	110,018	96,913
1878.....	43,826	39,013	82,839	84,330
1879.....	44,076	53,625	97,701	89,064
1880.....	47,604	77,997	125,601	92,296
1881.....	53,597	54,626	108,223	85,130
1882.....	57,309	48,103	105,412	85,947
1883.....	56,515	60,241	116,756	77,975
1884.....	55,731	43,549	99,280	77,102
1885.....	47,659	38,734	86,393	66,800
1886.....	44,101	28,329	72,430	62,516
1887.....	43,509	27,876	71,385	58,024
1888.....	43,605	33,240	76,845	56,028
1889.....	42,907	42,571	85,478	65,305
1890.....	40,258	34,867	75,125	55,112
1891.....	43,501	29,091	72,592	49,457
1892.....	43,476	26,661	67,137	54,987

CHAPTER XVIII.

NATIONAL CANAL CONVENTION OF 1863.

Less than a month after the defeat of the ship canal bill in Congress, a call was issued for a national convention to be held in Chicago to renew the agitation for an improved waterway between Lake Michigan and the Mississippi river. Although the country was occupied with a devastating war, this improvement was considered by the North of so much importance that it commanded the attention of every State not in rebellion. There were many who believed the military advantages of the enlarged channel were a sufficient reason for its construction, but these were no longer placed in the foreground.

The call for the convention was sent out from Washington on March 2, 1863. It said: "Regarding the enlargement of the canals between the valley of the Mississippi and the Atlantic as of great national, commercial and military importance, and as tending to promote the development, prosperity and unity of our whole country, we invite a meeting of all those interested in the subject in Chicago on the first Tuesday in June next. We especially ask the coöperation and aid of the Boards of Trade, Chambers of Commerce, agricultural and business associations of the country."

The call was signed by most of the prominent members of Congress. Among them were Isaac N. Arnold and E. B. Washburne of Illinois, A. G. Riddle of Ohio, H. L. Dawes, Charles Sumner, Amasa Walker and Henry Wilson of Massachusetts, Justin S. Morrill of Vermont, Samuel

C. Fessenden of Maine, James R. Doolittle of Wisconsin, S. C. Pomeroy of Kansas, A. B. Olin and E. G. Spaulding of New York, James Harlan of Iowa, Francis P. Blair of Missouri, Schuyler Colfax of Indiana, and Edward Bates, attorney general.

The convention met on June 2 and continued in session two days. The exercises were held in a tent on the lake shore, the seating capacity of which was 4,700. Besides the State delegations there were present representatives from many business associations of the country. The Chicago Board of Trade was represented by N. K. Fairbank, S. Clary, George Armour, C. H. Walker, J. Y. Munn, William Sturges, R. McChesney, N. K. Whitney, W. D. Houghteling, C. T. Wheeler, J. S. Rumsey, G. S. Hubbard, Charles Randolph and E. W. Densmore. Dr. Daniel Brainard called the convention to order, and Chauncey I. Filley, mayor of St. Louis, was made temporary chairman.

Mr. Filley read some resolutions which had been adopted by the St. Louis City Council, in which that body declared that it looked with much interest and anxiety to the accomplishment of the project proposed for the consideration of the convention. The president of the council had been instructed to appoint five members to represent the city in the convention, the mayor to act with them, and five delegates outside the council to represent the city.

Dr. Brainard delivered the address of welcome. He said the occasion which had called the convention together was one of no ordinary character. It was not the call of a famishing people, nor of cities threatened by hostile armies. It was the voice of men shut out from the markets of the world, oppressed by the excessive productions of their own toil, remaining wasting and worthless upon their own hands, depriving labor of half its rewards, discouraging industry and paralyzing enterprise. In their distress they called upon the National Legislature and failed to obtain the relief

which they had a right to expect. Now they appealed to the people themselves.

"Our fertile prairies," the speaker said, "lay for centuries untouched by the hand of agriculture, not because they were unknown, but because they were inaccessible. Their prosperity dates from the opening of the Erie canal, thirty-eight years ago. The increase of the West and its productiveness have all been the direct result and consequence of the construction of that and other channels of trade. To the genius of DeWitt Clinton these States owe their existence and the nation its present strength. Every city here is a monument to his honor. . . . The policy which he established has stood the test of time and secured the seal of success, but the results have so far exceeded his expectations that the channels he projected, enlarged and multiplied as they have been, are all filled to their utmost capacity. The increase of the West may be stopped, her fertile fields deserted for the mines of Oregon, California and Colorado, her bright future darkened and her people discouraged by the refusal of the Government to open those means of communication upon which her growth and prosperity depend. Her commerce begins to feel the chain which fetters it; her people already complain that the fruits of their labor are gathered up by others, and while carriers are enriched, consumers and producers suffer alike and are impoverished. Under these circumstances she asks of Congress to construct from the Mississippi river to the Atlantic a channel adequate to the carrying of her staples and supplying her wants without unnecessary delay or exorbitant charges."

This somewhat bombastic address closed with the assurance that the work proposed would not only join the lakes with the Mississippi river and the Atlantic, but it would form part of a great highway from the Atlantic to the Pacific, by means of which the wealth of Asia on the one

hand, and of Europe on the other might be grasped and made to pass through the bay of New York and the Golden Gate of San Francisco, thus encircling the whole earth, and bringing all nations to pay tribute and bow before the scepter of the country's commerce.

Hannibal Hamlin, Vice-President of the United States, was chosen president of the convention, General Hiram Walbridge, vice-president at large, and Colonel J. W. Foster of Illinois, secretary.

The scheme for a railroad to the Pacific, then incubating, came before the convention immediately after its organization. A delegate from Minnesota offered a resolution declaring that the construction of a northern, a central and a southern railroad from the Mississippi river to the Pacific ocean was properly a subject of national cognizance, while the enlargement of canals within the limits of States between the Mississippi river and the Atlantic ocean was properly a subject of State cognizance alone. The resolution provoked such opposition that it was laid on the table.

Among the resolutions presented was a series from the Mercantile Association of Chicago, the provisions of which were as follows :

1. To improve, under the authority of the General Government, slackwater navigation of the Illinois and Desplaines rivers by constructing locks and dams, 75 feet wide and 350 feet long, and to enlarge the present Illinois and Michigan canal to admit the passage of gunboats and the largest steamers from the Mississippi to the lakes.

2. To enlarge, under the same authority, the locks of the Erie and Oswego canals of New York to dimensions which will pass iron gunboats 25 feet wide, 200 feet long, and drawing not less than $6\frac{1}{2}$ feet of water, by which twin improvement gunboats might be massed by an interior route from New Orleans to Chicago, Buffalo, Oswego, New York,

Norfolk, Richmond and Beaufort, a distance of 4,300 miles, besides placing under the control of the naval power of the government the whole navigable system of the lakes.

A canal around Niagara Falls was proposed in another resolution, but this subject was ruled out of discussion.

The only fire-brand in the convention was thrown by the indignant author of the railroad resolution, who declared that Illinois, with her great wealth and resources, ought not to stand like a pitiful mendicant asking Congress to do what she could do for herself, and that New York ought not to be present supporting that "contemptible effort."

Mr. Washburne answered that the whole country was interested in the canal question, as the attendance at the convention proved.

Mr. Spaulding of Ohio declared himself for the first time in favor of a ship canal from the Gulf of Mexico to the Gulf of St. Lawrence and of the Niagara canal.

After some consideration of the question of improving the Mississippi river, resolutions expressing the results of the convention's deliberations were adopted. Their substance was as follows:

1. That we regard the construction and the enlargement of the canals between the valley of the Mississippi and the Atlantic as of great military, national and commercial importance. We believe that such enlargement to the capacity of passing gunboats from the Mississippi to Lake Michigan, and from the Atlantic to and from the Great Lakes will furnish the cheapest and most efficient means of protecting the northern frontier, and at the same time tend greatly to promote the rapid development and permanent union of our whole country.

2. That these works are demanded alike by military prudence, political wisdom and the necessities of commerce; such works will be not only national but continental, and

their early accomplishment is required by every principle of sound political economy.

3. That such national highways should, so far as practicable, be free, without tolls and restrictions. The convention would deprecate the placing of this grand highway in the hands of any private corporation or State. The work should be done by national credit, and as soon as its cost is reimbursed to the national treasury, it should be made free as the lakes to the commerce of the world.

An executive committee, composed of one delegate from each of the States represented in the convention, was appointed to prepare a memorial to the President and Congress of the United States, presenting the views of the convention, and urging the enactment of laws necessary to carry them into full operation. There was no practical result.

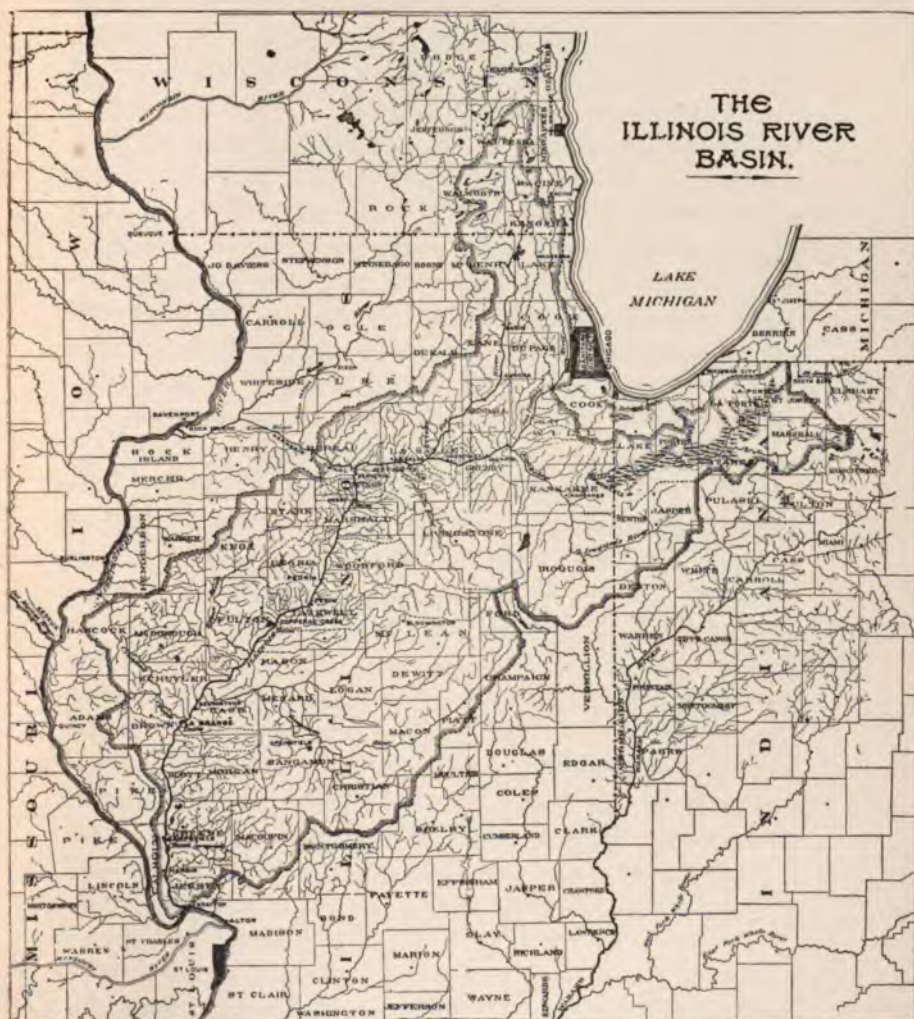
CHAPTER XIX.

IMPROVEMENT OF THE ILLINOIS RIVER.

A survey of the Illinois river was made under authority of the United States engineer department in 1838 by Captain Howard Stansbury, but no plan for the improvement of the river was adopted by the United States until 1852. On August 30 of that year Congress appropriated \$30,000 which was spent in dredging the channel. This work was done under the direction of Colonel J. E. Johnston of the topographical engineers.

In the fall of 1835 Governor Ford, in the interest of the State of Illinois, had caused a survey of the river to be made with a view to its improvement. This survey was conducted by G. R. Mowry, a civil engineer in the employment of the United States navy department, and the expense of it was borne by George Bancroft, secretary of the navy. Some nineteen or twenty bars were found in the whole length of the river, over which there were at the lowest stages only twelve to twenty-four inches of water. There were seventy-one shoals upon which the water averaged two to three feet in depth. In low water the channel of the river was quite narrow, in some places scarcely wide enough for two boats to pass.

At its session of 1847-8 the State Legislature passed a resolution requiring the committee on canals and canal lands in relation to the improvement of the Illinois river to inquire into the expediency of authorizing the improvement of its navigation by a law similar to the existing laws providing for the completion of the Illinois and Michigan canal.



TERRITORY DRAINED BY THE ILLINOIS RIVER.

This committee reported on January 18, 1848. The committee thought excavation would not answer the purpose because the parts excavated would very soon be found in their original condition owing to the very slight current in the river and the large amount of deposit furnished by the river's tributaries. A combination of improvement by wing dams and excavation would not succeed for similar reasons. The only method considered practicable was by locks and dams. For this kind of improvement the river was thought to be peculiarly fitted. Six locks and dams were recommended, the cost of which was estimated by Mr. Mowry to be \$492,092.70. This expenditure, he said, would secure a depth of three feet at all seasons and places. The locks were to be 200 feet long and 50 feet wide.

The State spent small sums of money from time to time in succeeding years, and on February 14, 1857, a charter was granted to the Illinois River Improvement company which proposed to do what the State was unable or unwilling to do. With a capital stock of \$3,000,000 the company expected to raise sufficient money to enable it to increase the depth of water in the Illinois river by a system of locks and dams sufficiently to pass boats drawing six feet of water. The locks were to be 350 feet long and 75 feet wide. The company's revenue was to come from tolls, rents and leases of water power. Among the forty-five incorporators were William F. Thornton, one of the canal commissioners in 1836, William B. Ogden, and John B. Preston, first general superintendent and chief engineer of the Illinois and Michigan canal. The company never accomplished anything.

The next systematic effort to improve the Illinois river was made in 1866, when under the authority of an Act passed by Congress and approved on June 23, a survey was ordered from the mouth of the river to La Salle. This work was placed under the direction of General J. H. Wil-

son. His report, dated February 15, 1867, and that of S. T. Abert, the engineer in immediate charge, contained the first definite information concerning the physical condition of the Illinois river and recommendations for its improvement. That of Mr. Abert is particularly valuable.

Mr. Abert said of the river that it was supplied by drainage from a prairie country exceeding in area 27,000 square miles. The gradual increase in its volume and its slow subsidence were attributed to the absence of mountains and hills within this area. The entire length of the river, including either tributary, the Kankakee or Desplaines, was about 330 miles. From La Salle to Grafton the length was 224 miles. The fall in the latter distance in the plane of ordinary low water was 29.6 feet. The fall in the high water plane of 1858 was 29.2 feet. With a sluggish current the river wandered through a valley of swampy land varying in width from one and one-half to six miles. During the period of the survey the banks were low, rising in many places to an elevation of three to eight feet above the surface of the water. Intersected by lagoons and swamps covered with a dense growth of willow, these bottoms seemed impenetrable. The general course of the river was noticeably direct, with sudden bends at La Salle and at Grafton. The straight reaches were almost invariably deep with muddy bottoms. The shallows occurred at elbows, confluent channels and the mouths of creeks. These were controlled by the general laws applicable to such a situation.

“Without stating the exact circumstances affecting each,” he added, “it may be said that all shallows below elbows are made in the dead angle of the eddy and are caused by the deflection of the current to the concave shore. The materials swept from the low grounds at high water, or brought into the river by the rain, are deposited in the neutral axes of confluent channels or where the river loses its velocity in a broad expanse, while the sand brought down by creeks will

be deposited at the point of conflict, if the streams oppose each other, or in the backward prolongation of the resultant of the two forces, if the streams approach each other in the same general direction. From the small amount of material brought down by the floods the shoals increase but slowly. The longest and deepest reaches occur between Henry and Lacon, Chillicothe and Peoria, Liverpool and Havana, Moscow and Browning, the depth for considerable distances varying from eighteen to thirty feet. For a distance of about fifteen miles above Peoria the river expands to about seven or eight times its ordinary width. The lower part of this fine expanse of water is known as Lake Peoria."

General Wilson was at first instructed to confine his operations to a survey of the Illinois river from its mouth to La Salle. Subsequently he was directed to continue his examination of the river as far toward its source as he might have reason to believe it was susceptible to improvement for purposes of commerce and navigation. The object, as stated by General A. H. Humphreys, chief of engineers, in his report to Congress, was to obtain such data as would enable the engineer department to form estimates for the improvement of the river so that the largest boats of the Illinois and Michigan canal, and steamboats drawing four feet of water, could pass through the river to the Mississippi during the season of extreme low water. General Wilson himself said in his report the supposition was that the survey had immediately in view the capacity of the Illinois river for navigation to La Salle for the largest class of steamers that the river would admit when certain obstructions should have been removed, and ultimately the determination of canal facilities with Lake Michigan, and the solution of the question of an adequate supply of water from Lake Michigan as a reservoir for the canal and river during periods of low water. The intentions of Congress were not fully known to the engineer department.

General Wilson recommended the improvement of the Illinois river by a system of locks and dams to be placed at such points between Lockport and La Salle as might be determined after a full and careful survey to be the most advantageous, and that navigation should be extended to the harbor of Chicago by the enlargement of the Illinois and Michigan canal to adapt it to the use of the largest boats plying upon the Mississippi. This would require a depth of seven feet both in the canal and river, the locks to be 350 feet long and 75 feet wide. These dimensions were sufficient to pass the largest boat, either of a commercial or naval character, that could navigate the Mississippi during the ordinary boating season, and could be made to pass naval vessels of greater draft by using camels or barges for lifting them partially out of the water.

It was not thought necessary to establish a depth sufficient to accommodate the largest lake boats since this would require at least fourteen feet of water. Such a depth could not be obtained either in the Illinois or the Mississippi except during freshets. Furthermore, lake boats, used for commercial purposes, would be unwieldy and unprofitable on the rivers, while the river boats could not be trusted at all upon the lakes. In other words, the produce of the West on its way to eastern markets must be transferred to a different class of vessels as soon as it reached the lakes. Hence, in determining the dimensions of the canal it would be sufficient to provide for the largest river steamboats. General Wilson was also impressed with the military advantages of the canal.

Six locks and dams were thought to be sufficient for the improvement of the river below La Salle, the estimated cost of which was \$2,587,697. Dredging, damages to lands and similar expenses would amount to \$536,099, a total of \$3,123,796. The cost of the enlargement of the Illinois and Michigan canal from Bridgeport to Lockport to a width

of 160 feet and a depth of seven feet he estimated to be \$10,098,000. The entire cost of the improvement from Lake Michigan to the Mississippi river he fixed at \$21,339,996, or about \$68,000 a mile.

By an act approved March 2, 1867, Congress directed the continuation of the survey of the Illinois river. General Wilson and William Gooding were appointed a Board of Engineers for the purpose of "conducting surveys and examinations and preparing plans and estimates for a system of navigation by way of the Illinois river between the Mississippi and Lake Michigan, adapted to military, naval and commercial purposes."

In the report submitted by the Board it was concluded that, in constructing such a system of navigation as the interests of the country required, the Government must follow the general line of the Illinois and Michigan canal and the Illinois river. The plan of improvement of the Illinois river suggested, was to create slack water in it from some point near Grafton to the head of Lake Joliet, passing the rapids at Marseilles by canal. A navigable depth of seven feet could thus be secured at the lowest stage of water in the river. A corresponding increase should be made in the capacity of the Illinois and Michigan canal. The cost of the entire improvement was now estimated to be \$18,217,242.56, less than \$2,000,000 of this amount to be applied to the improvement of the river. The Board considered the question of the improvement of the river by dredging and wing dams, but concluded it was doubtful whether this plan would insure a depth of more than four feet at extreme low water in a channel 160 feet wide whatever the expenditure. To supply water from Lake Michigan sufficient to create a navigable channel at all seasons was considered impracticable at any cost. Five locks and dams were provided to be located near Henry, Copperas Creek,

La Grange, Bedford and Six Mile Island, the total estimated cost of which was \$1,770,000.

Another year was spent in local surveys and examinations of the proposed sites for the locks and dams, and by an Act approved July 25, 1868, the sum of \$85,000 was appropriated by Congress for the improvement of the river. This amount was afterward withdrawn since it would require \$300,000 for the construction of a single lock and dam. An appropriation of the latter sum was asked for in the following year, but the request was not granted.

In the meantime the Illinois Legislature, by Acts approved February 28, 1867, and February 26, 1869, had taken steps for the construction of a lock and dam between La Salle and Peoria. The lock and dam were located at Henry, thirty miles below the junction of the Illinois and Michigan canal and the Illinois river at La Salle, and the construction was carried forward on the general plans recommended by the Government engineers. The cost to the state was \$400,000. The work was completed in 1871 and the lock was first put to use in January, 1872.

Two years later the Canal Commissioners reported that the improvement had accomplished all that its most ardent supporters had predicted. During an unprecedented drought the lowest stage of water in the Illinois river above the dam up to the junction with the Illinois and Michigan canal at La Salle, had been sufficient for all the needs of commerce; a greater depth of water had been maintained than existed on many of the bars in the Mississippi river between St. Louis and Cairo. The lock was 350 feet long and 75 feet wide, as originally suggested.

By Act approved July 1, 1873, the State Legislature appropriated the net proceeds of the Illinois and Michigan canal and the lock at Henry for the construction of a second lock and dam at Copperas Creek, sixty miles further down

the river, or ninety miles from La Salle. The cost was limited to \$400,000.

The United States Government and the State were now working in harmony for the improvement of the river, the pittance appropriated by Congress being used to the best advantage, as then wrongly understood. The latter had appropriated \$84,150 in 1869. This amount was used in dredging the bars between the dam at Henry and the site of the proposed dam at Copperas Creek, the original plan being to secure a depth of seven feet. General Wilson, in recommending this use of the funds, said: "Former dredgings on this river by the Government (in 1859) have demonstrated the fact that permanent improvements can be effected by this method."

Work by the national Government was begun in 1869. In the following year General Wilson modified his plan "better to subserve the interests of navigation," and the funds were applied to dredging an open channel 150 feet wide and four feet deep at low water, and to building catchments and wing dams where necessary. Bars which formed the greatest obstruction to navigation were dredged first.

Colonel J. N. Macomb, of the corps of engineers, succeeded General Wilson in charge of the work on the Illinois river in 1870, and remained in charge until 1877. During this period operations were continued by dredging, building wing dams, etc., on the plan adopted in 1870. In the year 1873, after the lock at Copperas Creek was decided upon, Colonel Macomb consented to use so much of the \$100,000 appropriated by Congress for the improvement of the Illinois river as might be necessary for the construction of the foundation of the new lock, after consultation with the Canal Commissioners. About five-sixths of this part of the work was done by the General Government at a cost of \$62,359.80 exclusive of engineering and miscel-

laneous expenses. The contract for putting in the foundation was let on August 12, 1873.

The lock and dam at Copperas Creek were completed and first used in October, 1877. The amount expended by the State in their construction was \$347,747.51, a total cost of \$410,107.31. As at Henry, this lock was 350 feet long and 75 feet wide. Either would pass a boat 300 feet long and 73 feet wide, drawing six feet of water, with a capacity of more than 2,000 tons. Twelve of the canal boats navigating the Illinois and Michigan canal, with a capacity of 2,100 to 2,400 tons, could pass through the locks at one lockage. It was agreed by General Wilson, representing the United States, in 1870, that the General Government would do the necessary dredging between the locks, which the State had then undertaken, or might undertake in the future, to build. The depth of water to be secured was seven feet. By partial dredging, lower dams were possible, and the overflow of low lands along the river would be reduced.

After the completion of the two locks and dams at Henry and Copperas Creek, the State undertook no further work of this nature, but has continued to exercise a control over that part of the Illinois river at and above Copperas Creek lock, collecting the tolls and keeping the locks and dams in repair. The Illinois and Michigan Canal Commissioners repeatedly urged the improvement of the river below Copperas Creek, and advised the construction of three more locks and dams. "By the construction of the proposed three additional locks and dams, 129 miles of waterway would be added," they urged in 1881, "which would complete a perfect water route from the lakes to the Mississippi river, thereby utilizing the present improvements, which, in low stages of water, do not benefit the lower part of the river country, and, in fact, leaves the

entire system of improvements as at present in a very incomplete state.”

The total cost of the three locks and dams proposed was estimated to be \$1,350,000. The cost of the two locks and dams already constructed was \$747,747. This amount was paid by the State. The General Government spent \$550,450.55 to June 30, 1880, in deepening the channels between and above the locks, the aggregate length of the dredged channels being about twenty-four miles. To maintain these channels and contract the waterway about 12,000 linear feet of brush and stone wing dams were built.

The further improvement of the river below Copperas Creek was undertaken by the General Government in a desultory way, an Act approved June 14, 1880, appropriating \$100,000 to be used in continuing the slack water system to the mouth of the river. Major J. G. Lydecker, who succeeded Colonel Macomb in charge of the river work in 1877, spent \$5,000 in a further survey of the lower part of the river. He concluded that a low water channel six feet deep and 200 feet wide could be obtained by dredging and the construction of wing dams, but the cost would be at least \$1,222,500. Besides, an annual expenditure of \$15,000 to \$20,000 would be required to maintain the channel. On the other hand, the survey indicated to him that by the construction of two locks and dams only there could be secured a reliable channel of navigation having a low water depth of seven feet over the worst portions of the river. The upper one should be in the vicinity of La Grange and the other near Columbiana. The cost of these two works would not exceed \$800,000. Some dredging would be required in the pools created by the dams to obviate building the dams unnecessarily high. The extreme limit of the cost of the works for a slack water system would not exceed \$1,000,000. The locks contemplated were of the size of those at Henry and Copperas Creek.

Major Lydecker urged that the first appropriation for each lock be not less than \$300,000.

By the passage of the river and harbor Act of June 14, 1880, Congress appropriated \$110,000 for the improvement of the river, requiring that \$100,000 of this amount should be applied to the construction of locks and dams. The remaining \$10,000 was to be used for dredging. There was also available \$38,699.45, a balance from previous appropriations on hand July 1, 1880. Major Lydecker's recommendation that two locks be constructed below Copperas Creek, instead of three, was approved by the chief of engineers. The sites selected were at La Grange, 150 miles below La Salle, and near Kampsville, opposite Columbiana, 45 miles further down the river, or 195 miles below La Salle. The locks, corresponding in size with those already built by the State of Illinois at Henry and Copperas Creek, were designed to be 350 feet long and 75 feet wide. The lift of the Kampsville lock would be 7.2 feet, and that of the La Grange lock 7.4 feet. The walls would be about twenty-two feet high with a vertical face of cut stone. Below the Kampsville lock it was proposed to improve the river by dredging and constructing brush dams or dikes, where necessary, to contract the general width of the river, or prevent the dredged material from being carried back into the channel. Dredging preparatory to the construction of these two locks was begun in the spring of 1881. Congress appropriated \$250,000 on March 3, 1881, for the continuance of the work. There had been expended to June 30 of that year \$34,471.77, leaving a balance on hand July 1, the beginning of the new fiscal year, of \$363,866.04.

The work on the La Grange lock and dam was carried forward slowly and was completed on October 21, 1889, when the lock was officially opened for business. The foundation for the Kampsville lock was completed on November 12, 1883. As there were no funds available for the

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continuance of the work, the supplies and machinery were transferred to the La Grange lock. The estimated cost of the locks and dams at La Grange and Kampsville was \$680,000. There had been expended to June 30, 1892, \$1,066,918.19. Captain W. L. Marshall, then in charge of the work, estimated that it would cost \$112,500 more to complete it.

By joint resolution of the State Legislature, adopted by the Senate on May 27, 1889, and by the House on the following day, the United States was requested to stop work upon the locks and dams at La Grange and Kampsville, and apply available funds and future appropriations to the improvement of the channel from La Salle to the mouth of the Illinois river, such improvement to be the creation of a channel not less than 160 feet wide and 22 feet deep, with a grade sufficient to create a current of three miles per hour from Lake Michigan to Lake Joliet, and to project a channel of similar capacity, and not less than fourteen feet deep from Lake Joliet to La Salle. This joint resolution was as follows:

“WHEREAS, The present addition to the low water volume of the Illinois River through the summit level of the Illinois and Michigan canal from Lake Michigan more than doubles the volume of water used in the estimate of 1868 for the channel below Peru, and adds 50 per cent to the volume used in the estimate of 1880 for the channel below Copperas Creek, and said contribution from Lake Michigan will be increased in the immediate future, thus enabling the depth now projected for navigation below Peru to be obtained by channel improvement at moderate cost, and with decided advantage to material interests and to healthfulness along the valley ;

“WHEREAS, It is contemplated to increase the volume from Lake Michigan to 300,000 cubic feet per minute within a few years, and ultimately to add 600,000 cubic feet

or more, thus enabling a large depth for navigation to be obtained by an improved channel, and that said channel will be self-sustaining and self-improving, and will discharge flood waters more readily, thus benefitting the bordering lands, and increasing the healthfulness of the valley :

.. WHEREAS, works now projected by the city of Chicago will form part of a waterway of large proportions from Lake Michigan via the Desplaines and Illinois rivers to the Mississippi river, of which the dams and locks upon the alluvial section of the Illinois river can form no part, and which, if allowed to remain, will increase, overflow, and be detrimental to the welfare of the Illinois valley and the interests of the State : Therefore, be it

.. Resolved, by the Senate, the House of Representatives concurring herein :

“1. That it is the policy of the State of Illinois to procure the construction of a waterway of the greatest practical depth and usefulness for navigation from Lake Michigan via the Desplaines and Illinois rivers to the Mississippi river, and to encourage the construction of feeders thereto of like proportions and usefulness.

“2. That the United States is hereby requested to stop work upon the locks and dams at La Grange and at Kampsville, and apply all funds available and future appropriations to the improvement of the channel from La Salle to the mouth with a view to such a depth as will be of present utility and in such manner as to develop progressively all the depth practicable by the aid of a large water supply from Lake Michigan at Chicago.

“3. That the United States is requested to aid in the construction of a channel not less than 160 feet wide and 22 feet deep, with such a grade as to give a velocity of three miles per hour from Lake Michigan at Chicago to Lake Joliet, a pool of the Desplaines river immediately

below Joliet, and to project a channel of similar capacity, and not less than 14 feet deep from Lake Joliet to La Salle, all to be designed in such a manner as to permit future development to a greater capacity."

By Act of June 4, 1889, the works at Henry and Copperas Creek were ceded to the United States. In the event of their non-acceptance within four years after the Act became a law, and under other conditions named, the Canal Commissioners were authorized to remove the dams at those points. The Act became a law on July 1, 1889, and the removal of the dams was thus authorized to take place on or after July 1, 1893. The Act was as follows:

"§ 1. *Be it enacted by the People of the State of Illinois, represented in the General Assembly*, That an Act entitled 'An Act to cede certain locks and dams in the Illinois river to the United States,' approved May 31, 1887, in force May 31, 1877, and ceding the State works at Henry and Copperas Creek, and the pools created by said works, to the General Government upon certain conditions as to the opening of a waterway of a depth of seven feet from the Mississippi river to Lake Michigan, upon plans to be determined by United States engineers, is hereby repealed.

"§ 2. That the State Works at Henry and Copperas Creek, and the river now slack watered by said works, are hereby ceded to the United States on condition that the dams shall be removed whenever the depth now available for navigation can be secured and maintained by channel improvement without the aid of said dams: *Provided*, that said depth shall be assured upon the removal of said dams, or that such removal shall not materially impair navigation.

"§ 3. That in the event of the non-acceptance of these works upon the conditions mentioned in section 2 within four (4) years after this Act becomes a law, the Canal Commissioners of the State of Illinois are authorized and

instructed to remove the dams at Henry and Copperas Creek.

“§ 4. That the State of Illinois bases this act of cession upon the condition that the plan of improving the Illinois river below La Salle by slack water maintained by dams and locks, be changed to a plan of improvement by means of an open channel in conjunction with a water supply from Lake Michigan.”

The second of the Government locks and dams, that at Kampsville, after a long cessation of the work, was completed in the summer of 1893, and the first steamboat passed through the lock on August 30 of that year. The entire cost of the locks and dams at La Grange and Kampsville was \$1,145,886. So far as the purposes of navigation have been served they appear to have been worthless; the river is as shallow in places as it was before the alleged improvements were begun. It has been found at great cost that a few pools of water a few miles in length created by dams do not make a river 300 miles long navigable.

CHAPTER XX.

GOVERNMENT SURVEYS BY WILSON AND GOODING.

General J. H. Wilson made an examination of the Illinois river in the early part of the year 1867 and suggested the desirability of continuing it to Lake Michigan. He even roughly estimated the cost of a channel seven feet deep from the Mississippi to the lake. The re-survey ordered by Congress on March 2, 1867, was to establish the cost with a greater degree of accuracy.

The report of Engineers Wilson and Gooding on the new survey was made on December 17, 1867, and was transmitted to Congress by General A. H. Humphreys, chief of engineers, with his concurrence. The engineers stated in their report that they had been guided by the following considerations: The selection of the best route for the purposes proposed, the capacity which should be given to the improvement to adapt it most fully to the requirements, and the accomplishment of the object with the least possible cost consistent with the magnitude and permanency of the improvement.

Three surveying parties were organized and placed under the immediate supervision of Civil Engineer James Worrall, "for the purpose of making a thorough and exhaustive examination of the entire region lying between the southern and western end of Lake Michigan and La Salle on the Illinois river, and also for the purpose of conducting a low water survey of the river from La Salle to its mouth."

To the first party was assigned the duty of surveying the line of the canal from Chicago to La Salle, the Des-

plains and Illinois rivers, and all the alternate lines which had at any time been spoken of, including that of Mud Lake. The second was directed to survey the Calumet and Kankakee rivers and the country lying between the Kankakee river and Lake Michigan, as well as the Fox river and a section of the lower Illinois. To the third party was given the assignment of a careful hydrographic survey of the bed of the Illinois river from La Salle to Grafton, paying particular attention to the location, cause, character and extent of different sandbars and obstructions to navigation during low water; also, to gauging the river and its tributaries and making examinations of the various points likely to be selected as sites for locks and dams.

The engineers concluded that the location of the existing canal from Bridgeport to the valley of the Desplaines could not be advantageously or economically changed. It was the best, cheapest and most direct route, they said, that could be found. More than enough work had been done on it to counterbalance the natural but not superior advantages of the slightly lower but more tortuous route by way of Mud Lake. The Calumet river and Saganaska creek route, along what was known as the Calumet feeder, would cost a great deal more than either of the others since it was longer and ended at a point where there was neither a natural nor an artificial harbor, and where it would be impossible to construct one which would answer the purposes of commerce and the national defense. It was found to be impracticable at any cost to use any part of the Kankakee river as a part of the system of navigation.

"We have therefore to recommend," Messrs. Wilson and Gooding said, "that the improvement in question shall be made by widening and deepening the present canal from Bridgeport to the head of Lake Joliet with the exception of a section of $11\frac{1}{4}$ miles between Summit and the Sag, where it will be cheaper to excavate an independent canal.

From Lake Joliet to Marseilles the line should follow to the bed of the river, the necessary depth being secured by a system of locks and dams. At Marseilles it will be necessary to construct a piece of independent canal in order to pass the grand rapids of the Illinois, striking the river again at or above Ottawa, as may be found to be most economical. From the latter point to the mouth of the river the necessary navigation should be secured by a system of dams and locks. It is also recommended that all the canal on this line should have a width of not less than 160 feet and a navigable depth of six feet, corresponding to the lowest known level of the water in Lake Michigan, and an average depth of between seven and eight feet; that the present Summit shall be cut down so as to secure this depth in the canal from the inexhaustible reservoir of Lake Michigan."

The locks were to be 350 feet long and 75 feet wide, with a minimum draft of seven feet. The slack water of the Illinois river was expected to secure a navigable depth of seven feet at the lowest known stages. No fact was better established, the engineers said, than this: The system of navigation between the Mississippi and Lake Michigan by way of the Illinois river should be adapted to the steamboats and barges employed in the navigation of the Mississippi and its principal tributaries, but not to ocean and lake vessels, except such as were required for the defense of lake commerce and lake cities.

Although it had been generally conceded that the only practicable route for the proposed improvement was by way of the Illinois and Michigan canal and the rivers below, it was thought best to settle the question beyond cavil. Colonel Worrall was instructed to make a survey of the Kankakee river from its mouth to the east line of the State of Illinois. The conclusions reached by him were as follows:

1. There was too great an elevation (100 feet where the

line was run) between the Kankakee and Calumet rivers through which the connection could be most cheaply made, if made at all.

2. The Kankakee river, which was forty feet above Lake Michigan at the State line, would not afford sufficient water to supply a canal and lockage both ways for a maximum business.

3. The distance would be fifty miles greater than by the Illinois and Michigan canal if the connection were made with the lake at the mouth of the Calumet, which was the best point south of Chicago.

4. It was believed to be impossible to construct a good and safe harbor at the mouth of the Calumet, available at all times, and no other should be adopted as the terminus of a canal by this route.

Another route by way of the Fox river, which formed a junction with the Illinois at Ottawa, had been suggested. Surveys were made and the conclusion reached that tolls sufficient to pay the cost of superintendence and repairs could not be collected, to say nothing of the cost of construction.

For a canal and river improvement of the capacity desired no other route could be compared with that by the Illinois river and the Illinois and Michigan canal. It followed the course of what was unquestionably once the great outlet of the lakes toward the Gulf of Mexico. On all the other routes proposed there was considerable ascent from the lake to the Summit, involving additional lockage and providing a supply of water from sources much less reliable than the inexhaustible reservoir, Lake Michigan.

Through the greater part of the distance from the Chicago river to the vicinity of Joliet the engineers were satisfied that it would be expedient to follow the line of the existing canal, enlarging and deepening it to the required capacity. The excavation for the old canal had determined

with considerable certainty the character of most of the material to be removed. The first eight miles, except two or three feet upon the surface, consisted almost entirely of indurated clay, exceedingly hard, but which was being successfully excavated by steam dredges. A few veins of quicksand had been found on this part of the line, but it was not believed they would cause serious embarrassment in the construction of the enlarged canal. The excavation would be from thirteen to nineteen feet below the surface.

Eight miles from Chicago the canal entered the valley of the Desplaines river and the excavation would be much more difficult. Throughout the succeeding eleven and one-fourth miles the greater part of the material consisted of cemented clay and gravel, or hard clay in which boulders were thickly imbedded. Probably most of this work could be done by powerful steam dredges, but the operation would necessarily be slow and expensive. In places there were considerable quantities of rock (stratified limestone) that would vary in thickness from two to ten feet. The depth of the excavation would vary from seventeen to nineteen feet.

At the distance of about $18\frac{1}{2}$ miles from the beginning of the canal at the Chicago river there was encountered a barrier of stratified limestone which extended entirely across the valley and continued to the running out of the lake level near Lockport. This rock was covered with a slight alluvial deposit from one to two feet in thickness. From the commencement of the rock excavation a mile below the mouth of the Calumet feeder to Summit lock No. 2, below which the canal was completed on the deep cut plan, the levels on the natural surface of the rock ranged from eleven to eighteen feet. Over this distance of $7\frac{1}{8}$ miles there remained to be excavated to complete the canal on the original plan only 235,000 cubic yards of rock, 1,000,000 having been already excavated.

The estimates for the Summit division comprehended a

canal the bottom of which would be six feet below the very lowest stage of Lake Michigan. At an average low stage of the lake there would be a depth of not less than seven feet, and at the time of the survey a medium stage of eight feet. The highest stage during the previous thirty-one years would have given a depth of ten feet.

It was intended to give a declivity to the bottom of the canal upon the original plan of .10 of a foot per mile, or 2.9 feet for the whole Summit division. The new levels showed some five inches less, but the declivity was considered sufficient.

From Chicago to Lockport, where the first lock below the lake level was located, it was proposed that the large canal should occupy the bed of the existing canal, for the greater part of the distance. Where the line was changed it should be mainly with a view to increased facilities in construction and not because any particular advantage could be gained in the nature of the ground. There would be no advantage in a deviation through the upper half of the distance from the existing line between Lockport and Joliet. Below that point three lines were surveyed to the head of Lake Joliet.

The first of these lines followed the existing canal through Joliet, and the pools formed by the two dams across the Desplaines would be occupied by the proposed improvement. These dams were built of stone upon a rock foundation, and having stood for more than twenty years without injury might be regarded as sufficiently permanent. A short distance below the lower dam the line for the proposed improvement would leave the canal and be constructed in as direct a line to the head of Lake Joliet as practicable.

The second line abandoned the canal near the State Penitentiary and passed through the eastern part of the city in a depression known as the slough crossing Hickory

creek, thence following near the foot of the bluff on the east side of the valley to the head of the lake.

The third line followed the foot of the bluff on the east side of the valley, running entirely outside the limits of the city of Joliet to the head of the lake.

From the head of Lake Joliet to La Salle no part of the canal could be made available if the Desplaines and the Illinois rivers were occupied by any portion of the improved channel, and the engineers recommended the river route for the entire distance between these points. Besides, at two or three points, as at the Kankakee bluffs near the junction of the Kankakee and Desplaines rivers, and at the Rockwell bluff, a short distance from La Salle, the canal could not be enlarged to a width of 160 feet except at very great cost and at great risk of being insecure. The construction of bridges, culverts, waste weirs, ditches, etc., and three or four expensive aqueducts, would constitute a most serious objection. The construction of vertical or slope walls through all earth work would be expensive.

From Marseilles to Ottawa, where the fall in the Illinois river was very rapid, including what was formerly known as the grand rapids of the Illinois, it was thought best to construct an independent canal on lower levels than the existing canal. This canal might be brought back into the river at a point two miles below Marseilles, or at the mouth of Fox river, depending in some degree upon the local manufacturing interests which should be accommodated so far as could be done without materially adding to the cost of the work or marring its efficiency for the purposes of navigation.

"It has been asserted," said the engineers, "that it is unnecessary to provide for a navigable depth of seven feet in the Illinois river when the Mississippi river itself below the mouth of the Illinois has at times a less depth than this. We have fully considered this objection, urged mainly

against the improvement by locks and dams, and for the following reasons think it should be disregarded :

“ 1. There is usually but a short period during the season of navigation when there is not a depth of water of six or seven feet in the Mississippi river below the mouth of the Illinois, and frequently the Mississippi, being high from melting snow about its source or that of the Missouri, affords good navigation for the largest boats when the Illinois is scarcely navigable at all.

“ 2. We entertain no doubt that the depth of water in the Mississippi from the mouth of the Illinois to that of the Ohio can be materially increased during the dry season by a judicious system of improvement. The interests of commerce and navigation now require and must necessarily compel the commencement of such an improvement before the lapse of many years.

“ 3. It is manifestly necessary to secure a depth of at least seven feet which shall be always available if this artificial navigation should ever be required for military and naval purposes, and we deem it sound policy to secure this depth of water for commercial purposes if it can be done without a disproportionate cost. It is a well known fact that vessels of every class are propelled at much greater speed and economy in deep than is possible in shallow water.

“ 4. The depth of seven feet through 322 miles of navigation, traversing one of the most productive countries of the world, can be secured beyond any contingency by the plan proposed, at a cost slightly, if any, in excess of what it must cost to make an open channel navigation only four feet deep. When it is considered that it is by no means certain that the latter is practicable at any cost, and that the former would be at least three times as valuable for all purposes, there remains but little room to doubt which plan should be adopted.”

This system of improvement would submerge but little, if any, valuable land, the engineers continued. The height of the bottom lands above low water in the river, except such as were already low and marshy and inundated by a slight rise of water, was generally not less than ten to fifteen feet, and in many places from ten to twenty feet. The maximum height to which the water at the lowest stage would be raised by the highest dam would be only six to seven feet at the dam, and this would gradually diminish from the lower to the upper end of the pool, where it would be raised only two or three feet. All such lands, therefore, as would be overflowed by the construction of the dams would be already overflowed by a slight rise of the river and could not consequently be considered very valuable. From extensive observation and inquiry the engineers were of the opinion that the influence of these dams upon the health of the country lying immediately along the river would be beneficial rather than injurious.

As to the sandbars in the Illinois river, most of them were due to local causes and were undergoing but little change. Dams in the affluent streams might prevent sedimentary deposits from being brought in.

The objections which had been urged against a slack-water improvement of the Illinois river from La Salle to its mouth had induced many of the best engineers in the country to investigate the subject and devise different plans. Those which had been most generally advocated were:

1. By dredging and wing dams.
2. By drawing a sufficient supply of water from Lake Michigan to give the requisite depth to the Illinois river.

The navigation of the river, Engineers Gooding and Preston thought, might be much improved by the first method, but it was doubtful whether any amount of ex-

penditure upon this plan would give an available depth for navigation of more than four feet at extreme low water in a channel 160 feet wide. Even the increase in the supply which would be given by deepening the Illinois and Michigan canal on the Summit division would not give depth enough for canal boats passing through the canal in its existing unimproved condition.

The plan of supplying sufficient water from Lake Michigan to make a navigation of the Illinois river suitable for the largest class of steamboats without the intervention of dams and locks, was thought impracticable at any reasonable cost. To obtain the requisite amount of water from the lake without excavating a wider channel than recommended, the channel would have to be about thirty feet deeper opposite lock No. 1, or ten feet deeper than the bed of the Desplaines river opposite the town of Lockport. It would increase the depth of excavation for the first ten miles above that point an average of twenty-five feet. Although the average depth below the bottom upon the plan proposed would be much less through the earth excavation, the difficulty of executing the work would be increased in a much greater proportion than the depth.

By diminishing the declivity, and therefore the depth, the width of the canal would be so greatly increased that there would be no great difference in the cost, which would exceed by more than \$20,000,000 the cost of the improvement recommended. The only gain by this additional expenditure would be the saving at most of four or five dams and locks in the Illinois river. As the current would be considerably accelerated, the value of the improvement for navigation would be diminished rather than increased. Through a channel of the dimensions recommended, there could be drawn from Lake Michigan all the water necessary for navigation, for cleansing the Chicago river effectually, and for an immense manufacturing power.

The Illinois river below La Salle, it was urged, should be first improved. The appropriations of lands by the United States, and the construction of the Illinois and Michigan canal were based upon the supposition that the Illinois river was navigable. Such was not the fact, the engineers said. There had scarcely been a season since the canal was completed, twenty years previous, when there had not been a serious interruption to navigation, caused by low water in the river. The evil was becoming worse as the country was improved, and the usual supply of water in the summer was reduced. The improvement of the Illinois river was estimated to cost \$1,953,600, and the engineers recommended an appropriation of that amount for the purpose.

Colonel J. O. Hudnutt of Chicago surveyed a canal route from Rock Island to Hennepin in 1866 which has since been adopted substantially for the present so-called Hennepin canal. General Wilson and Mr. Gooding investigated the route in the following year, and reported that their surveys demonstrated the entire practicability of a canal from the Illinois river at or near the mouth of the Bureau to the Mississippi at or near Rock Island. The length of the canal would be about 64 miles, and it would be supplied with water by a navigable feeder 38 miles in length from Rock river at Dixon. The cost of such a canal 60 feet wide and six feet deep, with that of the feeder, was estimated to be \$4,600,000. This would secure a cheap and direct navigation to the lakes and a choice of markets to all the country drained by the upper Mississippi and its tributaries.

Messrs. Wilson and Gooding estimated the total cost of the improvements from Lake Michigan to the Mississippi river as follows:

From Chicago to Lockport, including what is known as the Summit division of the canal, 29 miles.....	\$11,249,173 98
From lock No. 1 at Lockport to lock No. 8 at the head of Lake Joliet in the Desplaines river, 7 miles....	2,095,546 58
From lock No. 8 to Marseilles, all in river except short canals at locks and dams, 40 miles.....	1,256,806 77
From Marseilles to Ottawa, 6 miles.....	988,880 75
From Ottawa to La Salle, all in river except short canal at dam, 17 miles.....	688,784 58
From La Salle to mouth of river, 228 miles.....	1,958,600 00
Total.....	<u>\$18,217,942 56</u>

CHAPTER XXI.

GOVERNMENT SURVEYS BY BENYAURD AND MARSHALL.

Congress authorized a survey for a canal from Hennepin to the Mississippi river by an Act passed August 2, 1882. Supplementary to this it also ordered a new survey of the Illinois and Michigan canal and an estimate of the cost of its enlargement to the size of the Hennepin canal. Major W. H. H. Benyaurd was the government engineer then in charge of the river and harbor work in the vicinity of Chicago.

In the prosecution of these surveys Major Benyaurd organized three surveying parties, one of which gave its attention to the Illinois and Michigan canal. The work on the canal division was conducted by George Y. Wisner. He determined cross sections of the canal at intervals of 500 feet throughout its entire length. His estimates were for a canal 80 feet wide at the surface, 59 feet at the bottom and seven feet deep, with locks 170 feet long, 30 feet wide and seven feet deep. The sectional area was 485 square feet, or about 25 per cent greater than that of the existing canal. The lockage, which was all descending, amounted to 141.5 feet, requiring sixteen locks varying from 6.5 to 13.5 feet. The water was to be supplied by the pumps then in course of construction at Bridgeport. It was proposed not to make any change on the line of the canal, nor in the number and location of the locks and other structures. The estimated cost of the enlargement of the canal and auxiliary works was \$2,298,919.15.

The survey was continued the second year from dam

No. 1 on the Desplaines river at Joliet to a point on the Illinois river near La Salle, where the Illinois and Michigan canal enters the pool created by the lock and dam at Henry. Major Benyaurd and his assistant, Mr. Wisner, found that the two rivers had an average width of about 600 feet, with the banks from eight to twenty-three feet in height above low water. Within ordinary stages the streams flowed between fixed banks. The oscillation between high and low water was about fifteen feet, although a height of twenty-three feet had been recorded, occasioned by an ice gorge. The fall in the low water surface between the points named, a distance of 64.2 miles, was 100.25 feet. This fall was not equally distributed over the entire distance, but occurred at various points, principally at the ripples separating the different pools, amounting in some places to ten feet per mile.

It was evident to Major Benyaurd that the only feasible plan to render the streams navigable was to slackwater the entire distance. This could be accomplished by the construction of nine locks and dams. His plan also contemplated the construction of short canals at the falls of Joliet and Marseilles. Certain low lands would necessarily be submerged, but these, he said, had little value. The river route had such an apparent advantage over the canal that it was difficult for Major Benyaurd to understand why the canal had been originally constructed rather than the river improved between Joliet and La Salle. The estimated cost of the improvement of the rivers from Joliet to La Salle, with locks having chambers 350 feet long and 75 feet wide, corresponding with those on the lower Illinois, was \$3,433,562; with locks 170 feet long and 30 feet wide, the dimensions for those of the Hennepin canal, the cost would be reduced to \$1,975,446.

On August 11, 1888, Congress appropriated \$200,000 for the improvement of the Illinois river. The Act making the appropriation also contemplated a survey for a service-

able waterway from Lake Michigan to the Mississippi river, as shown by the following clause: "And for the purpose of securing a continuous navigable waterway between Lake Michigan and the Mississippi river, having capacity and facilities adequate for the passage of the largest Mississippi river steamboats, and of naval vessels suitable for defense in time of war, the secretary of war is authorized and directed to cause to be made the proper surveys, plans and estimates for a channel improvement and locks and dams in the bed of the Illinois and Desplaines rivers from La Salle to Lockport, so as to provide a navigable waterway, not less than 160 feet wide, and not less than fourteen feet deep, and to have surveyed and located a channel from Lockport to Lake Michigan, at or near the city of Chicago, such channel to be suitable for the purposes aforesaid." Captain W. L. Marshall, who succeeded Major Benyaurd, was then in charge of the river and harbor work in this vicinity. In a letter of instructions from General Thomas L. Casey, chief of engineers, Captain Marshall was directed, whatever line might be found most advantageous and economical to the United States, to submit plans and estimates for a route terminating within the limits of Chicago, sufficiently distinct and in detail to enable the chief of engineers to form a definite and conclusive opinion as to its merits from the standpoint of the commercial and sanitary interests of Chicago.

A survey party was organized and put in the field October 1, 1888, under the charge of Assistant Engineer L. L. Wheeler. By December 1, 1888, the field work relating to the superficial survey of the several practicable routes from Lake Michigan at or near Chicago by way of the Chicago Divide and the Desplaines river valley as far as Joliet were practically completed. The survey made by Major Benyaurd and Engineer Wisner in 1883 from Joliet to La Salle was adopted, so far as it was sufficient for the purpose, to avoid unnecessary complication of work and expense.

In his exhaustive report Captain Marshall said there were two practicable routes across the Chicago Divide. One was by way of the Chicago river, the South branch and the Illinois and Michigan canal, or Mud Lake and the Ogden ditch, to the Desplaines river near Summit, about twelve miles from the city hall of Chicago and about eight miles from Bridgeport; thence by way of the Desplaines river valley.

The second route was by way of the Calumet and Little Calumet rivers to Blue Island, thence westward along the old Calumet feeder route to the Desplaines river at Sag, where the two routes became common. There was a practicable detour from the second route which left the old feeder line a short distance west of Blue Island and continued in a more direct line south of Lane's Island, uniting again with the feeder line about five miles east of Sag bridge.

Captain Marshall did not favor a deep cut across the Chicago Divide at the expense of the United States and for the sanitary benefit in part of the city of Chicago. He sought to secure a modification of his instructions limiting the survey under his direction to a channel of smaller dimensions. He addressed a communication to General Casey, on May 1, 1889, in which he stated that local necessities, for sanitary reasons, demanded a large discharge from Lake Michigan into the Illinois river. Navigation interests, he said, did not demand an increased discharge into the Illinois river, but such discharge would result in a positive injury to navigation. A navigable channel demanded no slope to the costly cut through the Chicago Divide, but local sanitary necessities required a slope of not less than four inches to the mile and a cut deeper by about seven to eleven feet in rock and three to seven feet in earth. He asked the department whether it desired that the estimates demanded by Congress should be

rendered on the basis of the requirements of navigation, or whether the local drainage problem should also be considered.

Captain Marshall was asked in turn by the department for suggestions. In his reply he appeared to regret that the Act of Congress did not allow the capacity of the channel to be determined by the consideration of the size and draught of Mississippi river steamboats that could reach the mouth of the Illinois river. He desired to make the estimates required by law for a 14-foot channel, and for an 8-foot channel also, as required for steamers navigating the western rivers, leaving such modification of the channel as might be required by local sanitary necessities to be attended to by local authorities.

General O. M. Poe, engineer of the Northwest division, endorsed the communication of Captain Marshall with this remark: "It does not appear that the project for a 14-foot channel must necessarily cover the whole distance from Lake Michigan to the Mississippi river, but may be limited to the portion between La Salle and Lockport. The only requirement imposed by the law for the remainder is that it shall provide for a channel having capacity and facilities adequate 'for the passage of the largest Mississippi river steamboats and of naval vessels suitable for defense in time of war.'"

The communication was forwarded to General Casey who issued this order: "Surveys, plans and estimates for a 14-foot channel as required by law, and for the 8-foot channel required by western river boats, should be made in the interest of navigation. Modifications required to adapt to local wants the navigable channels thus surveyed should be left to local authorities."

In his suggestions Captain Marshall seems to have been guided by a predetermination that a channel for navigable purposes would never be extended to the Chicago river

through the upper Desplaines valley. In fact, he said in his report of the surveys, in direct opposition to the views of Government engineers who had preceded him, that the terminal facilities at the mouth of the Calumet river, "the ample land-locked natural basins (needing only deepening by dredging) for the construction of a great development of wharves and docks in public waters of the United States, scarcely excelled anywhere on the Great Lakes," pointed irresistibly to the Calumet region as the proper terminus of a great waterway between the Great Lakes and the Mississippi river. Under the direction of Captain Marshall large sums of money have since been spent by the Government in creating a channel in the bed of the Calumet river nearly a mile in length, 250 feet wide and 16 feet deep.

Acting under the orders received from his chief, Captain Marshall made surveys and estimates for two channels, one fourteen feet deep and the other eight. In his report, preliminary to an explanation of his plans, he analyzed the navigation of the Mississippi river and such of its tributaries as would be served by the proposed waterway. In the Desplaines and Illinois rivers the practical depth of navigation after the construction of the smaller channel, would vary with the stage of the rivers. From Joliet to La Salle there would be a navigable channel varying in depth from eight feet, when the discharge of the river was at a minimum, to ten to sixteen feet at mid-stages. Below La Salle to the Mississippi river there would be a depth of navigation varying from seven feet at extreme low water, to twelve feet at mid-stage and eighteen feet or more at floods. The minimum low water depths sought on the Illinois river were greater than those proposed for that portion of the Mississippi river with which it immediately connected.

The 14-foot channel would accommodate with increased facility all large vessels that could reach its terminus at La Salle through the channel of the Mississippi river. But

vessels on the Mississippi that could not be accommodated by the 8-foot channel at extreme low water would not be accommodated by the 14-foot channel 160 feet wide, although a channel fourteen feet in depth at extreme low water in Lake Michigan to eighteen feet at high water across the Chicago Divide, could be navigated by large boats, if there were still water or a very moderate current, with greater facility than a still water channel eight to twelve feet in depth.

This was the best argument for such a channel, based upon the present or probable future navigation of the Mississippi river and its tributaries, Captain Marshall said, but it was not a public necessity. No greater depth of channel than nine feet at extreme low water in Lake Michigan across the Chicago Divide seemed to him necessary for navigation by vessels similar to the largest Mississippi river craft that could neither use it nor reach it. But a channel of much greater capacity, discharging a large volume of water into the Desplaines and Illinois rivers not necessary for navigation in a canalized river, as this must necessarily be, was made locally urgent by the sanitary necessities of the city of Chicago for drainage and an uncontaminated water supply. These necessities ended when the Chicago Divide was passed and the discharge turned into the channels of the rivers.

Beyond the Chicago Divide there was no apparent necessity then nor likely to exist in the near future, either national or local, for a channel of materially greater capacity than the minimum estimated for between the Mississippi river and the Great Lakes, although every increase in depth and width up to a certain limit throughout the artificial channel would increase the facilities for navigation, probably without affecting the character, size or draught of the boats that would use it as a through route of transportation.

The two routes for which estimates were made by Cap-

tain Marshall, one by way of the Chicago river and the other by way of the Calumet river and the Sag, united at the Sag bridge, about seventeen miles respectively from Bridgeport and Blue Island. From Sag to La Salle they coincided. The Chicago route followed the Chicago river from its mouth by way of the South branch to a point near Bridgeport, the West fork of the South branch and the Ogden ditch to Summit, thence parallel with the Illinois and Michigan canal on lower ground for about three miles, and entered the bed of the Desplaines river. Cutting off bends it followed the Desplaines river to the Sag bridge. This route was preferred to the line of the Illinois and Michigan canal for these reasons :

It occupied lower ground, and the probable amount of excavation was less, since the earth excavated from the old canal remained as spoil banks to be removed.

The old canal was paralleled by a railroad on either side, and there was not sufficient room for the enlargement of the canal without condemning the railroad right of way and removing one or both of the tracks.

The present canal was the property of the State of Illinois, and the conditions of transfer had not been accepted by the United States. These conditions were such that their acceptance would involve greater cost than a new right of way.

The Illinois and Michigan canal was the main sewer of the city of Chicago, as well as a commercial highway, and could not well be enlarged without seriously interfering with its uses, or at increased cost of work from delays due to traffic on the canal.

As a means of transportation and drainage it was of advantage in the prosecution of the work parallel with it that it should be maintained in a serviceable condition during the construction of the larger canal.

The new route avoided excavation in solid rock for

several miles, between Willow Springs and Lemont, which was found in the bed of the old canal.

The proposed Sag, or Calumet river route, followed the Calumet river from Lake Michigan to One Hundred and Tenth street, thence by way of a cut-off through Lake Calumet to its southwestern shore, thence by another cut-off to the Little Calumet river, thence to Blue Island, and nearly due west along the line of the old Calumet feeder north of Lane's Island to the junction of the two routes at Sag bridge. The line through Calumet lake was more expensive than by way of the rivers to Blue Island, but was preferred because it was five miles shorter, and because Lake Calumet afforded greater facilities for the construction of an "unobstructed land-locked harbor of great proportions, affording ample room for a turning basin and great development of docks and wharves suitable for an extensive commerce and easy transfer between lake and river steamers." The route north of Lane's Island, although about two miles longer than the direct line south of the island, was preferred because the material to the south for several miles was a soft muck, peat and vegetable matter, in which it would be extremely difficult and expensive to maintain a definite channel.

The table below gives the comparative cost of the two routes from Lake Michigan to Sag bridge. Captain Marshall believed the Sag route for which he had prepared estimates was the most advantageous, but not the least expensive. The guard lock was to prevent Desplaines river flood waters from passing into Lake Michigan, carrying with them Chicago sewage. No estimate was made for damages to adjacent property due to the reconstruction of bridges in Chicago, which would be a large item, nor for the increased cost of the work over the Chicago river route due to the assumed interruption by Desplaines river floods.

Comparative cost from Lake Michigan to Sag Bridge.

Item of cost.	Chicago route.			
	14-foot project.		8-foot project.	
	Units.	Cost.	Units.	Cost.
Right of way	-----	\$1,197,250	-----	\$1,197,250
Bridges	34	2,865,000	34	2,865,000
Rock	497,800	796,480	251,000	401,600
Earth	413,000	165,200	413,000	165,200
Hard pan	9,989,000	2,497,250	6,730,000	1,682,500
Guard lock	1,360,000	816,000	920,000	552,000
Docks	1	368,130	1	283,819
Revetments	*11,500	172,500	*11,500	172,500
Contingencies, 10 per cent	*84,000	840,000	*84,000	672,000
Total cost	-----	\$10,689,591	-----	\$8,791,056

Sag route.

Item of cost.	14-foot project.		8-foot project.	
	Units.	Cost.	Units.	Cost.
Right of Way	-----	\$ 272,150	-----	\$272,150
Bridges	27	1,055,000	27	1,055,000
Rock	1,264,700	2,023,520	536,800	858,880
Earth	13,814,000	3,453,500	9,562,000	2,390,500
Hard pan	944,000	506,400	703,000	421,800
Guard lock	1	357,649	1	268,309
Docks	-----	-----	-----	-----
Revetmen	-----	-----	-----	-----
Contingencies 10 per cent	-----	772,819	-----	526,664
Total cost	-----	\$8,501,041	-----	\$5,793,303

Uniting at Sag bridge the alternative routes followed the bed of the Desplaines river to a point below Lockport. The 14-foot channel was cut through solid limestone rock to

its full depth from a point 134,000 feet from Lake Michigan to a point 168,000 feet distant, partly in rock from 126,000 to 134,000, and also partly in rock from 168,000 to 184,000 feet, where the bottom of the 14-foot channel reached the surface below Lockport. The line from Lockport to Joliet followed the west side of the Desplaines valley.

Descending by four locks in the 14-foot project, and five locks in the 8-foot project, the channel entered the second basin at Joliet. Waste gates were provided below Lockport to vent the waters of the Desplaines at such times as they might exceed the necessities of the canal and overtop the guard lock gates, and were of sufficient capacity to vent the natural high water discharge of the Desplaines.

The canal below Lockport in both projects was almost entirely in embankment, or above the natural surface, the hillsides to the west forming one embankment of the canal, and substantial masonry retaining walls, laid in cement mortar and backed with the stone from the excavated parts of the canal, forming the other side. This substantial construction was recommended for the security of the city of Joliet, which lay below the level of the canal. From the first lock at Lockport to a point below Joliet the bottoms of the channels in both projects were made to coincide. The difference in cost was due to the different heights of the lock walls, retaining walls and dams. The excavation in both projects would be the same throughout this section.

At Joliet it was proposed to remove both State dams; to lower the water surface of the first pool two feet for the 14-foot project, and to raise the surface of the second pool eight feet, building substantial masonry retaining walls five feet above the constant water level; to build a new dam at the foot of this pool and place it in a movable section or sluiceway closed by a controllable gate to vent floods; to construct along the retaining wall on the east side a culvert or drain to carry off sewage and sipe water; to widen the Illi-

nois and Michigan canal by rock excavation to 160 feet; to deepen it eight feet by raising the canal embankment by constructing masonry retaining walls; to insert in this wall, if necessary, additional sluiceways closed by cylindrical gates to supplement the discharge through the sluiceway of the dam at floods; to build below these sluices a guard lock, and to continue the level to a point one and one-half miles below Joliet where a lock of eight feet lift would be placed again to return to existing levels in the Illinois and Michigan canal. The line would then abandon the existing canal and run in a direct line to Lake Joliet and thence to La Salle, occupying the Desplaines river, except at Marseilles, where a short canal would be constructed around the rapids at that point.

For the 8-foot project at Joliet the upper basin would be lowered eight feet, the dam at the end of the second basin raised two feet, the canal banks raised two feet and the canal widened as before. To vent flood waters the constructions would be similar to those for the 14-foot project. The level of the Illinois and Michigan canal, if it were used after the completion of the larger work, would need to be raised two feet. In the river portion of the route the required depths would be obtained by the aid of dams, so far as practicable. The dams were proposed to be as high as admissible, additional depths required to be obtained by excavation in the beds of the rivers. The water surfaces were common to both projects.

The mechanical constructions proposed were: For the 14-foot project, three guard locks, one combined lock of two lifts and fifteen lift locks from Lake Michigan to La Salle, the total lockage being 141 feet; for the 8-foot project, three guard locks and sixteen lift locks, with one set of waste gates for each project at Lockport. There would be nine dams, one of which, at Joliet, would be provided with a controllable sluiceway, and two others, one at Sugar

Island near Morris, and one at the foot of the slope at Utica, with navigable passes closed by wickets. These were the only locations where it would be practicable to employ movable dams, the slope of the rivers making permanent dams necessary. The locks at all fixed dams would be carried above the high water mark and the discharge of the river forced by levees or embankments over the crests of the dams.

The total estimates for the two projects from Lake Michigan to La Salle were as follows :

For the 14-foot project—	
Via the Chicago route.....	\$48,282,763.
" Sag route.....	46,094,213
For the 8-foot project—	
Via the Chicago route.....	\$26,883 153
" Sag route.....	23 885,400.

In discussing the comparative advantages of the two routes from Lake Michigan to Sag bridge, Captain Marshall said if the Chicago river could be made at reasonable expense to accommodate the increased commerce that the opening of a through route of great capacity would probably bring about, there would be no question of the proper terminus of the line. But the river was very crooked and obstructed by swing bridges, nearly all of them of less than eighty feet span. The main river and the South branch cut off the business center of the city from the populous North and West sides, and it required the most careful management by city officials to accommodate pedestrians, vehicles and passing vessels. This great inconvenience, notwithstanding the use of quick-turning bridges, was becoming more burdensome and annoying both to land and marine interests. The river could not accommodate any material increase in the number of vessels using it. Captain Marshall thought it only a question of time when the purposes of navigation would be met by the use of barges and tugs, making fixed bridges across the Chicago river a possibility,

and by the construction of an extensive outer harbor for lake vessels with wharves and docks along the lake front of the city, or by the utilization of the facilities of the Calumet system of lakes and rivers.

In its present condition the Chicago river could not be navigated at all by large Mississippi river steamboats. Nearly all the bridges, which were the property of the city of Chicago, would need to be reconstructed, if the Chicago river route were adopted, and there would be a considerable increase in the already too great number of vessels using the river. No large Mississippi river steamboat could turn in the river. It would need to run the gauntlet of all the bridges and piers to Lake Michigan unless a turning basin were constructed. In the construction of a channel by this route the waters of the Desplaines river must be contended against, and they might greatly increase the cost.

In supporting his preference for the Calumet river route Captain Marshall said the Calumet harbor was about completed, and the United States had secured the riparian rights to the river front from the mouth of the river at the harbor to the forks of the Calumet, or the present outlet to Lake Calumet. This section of the river the Government was then engaged in dredging to a depth of sixteen feet and a width of 200 feet. The Grand Calumet river extended for miles nearly parallel to and a short distance from Lake Michigan from "The Forks" in the State of Illinois to its old mouth in the State of Indiana. With its lakes it offered commodious basins and easy and comparatively inexpensive connections at many points between the proposed channel and Lake Michigan.

The Calumet river had been recognized by appropriations made by Congress as one of the navigable rivers of the United States. The United States was the riparian owner a considerable distance along the river and could control the bridging of the stream absolutely. The development of

the region thus far had been such that without great expense the terminal facilities might be made adequate for the heaviest commerce. The tendency of events was toward the development of water traffic and not toward its decadence, as was assumed with reference to the Chicago river. The estimated cost of the route Captain Marshall favored was less than by way of the Chicago river. The execution of the work would be easier, he said, as there were no rivers whose floods might delay it. Finally, there was no strong local necessity not associated with the interests of navigation to control or interfere with the execution of the work on a strictly national basis.

Concerning the practicability of the Calumet route Captain Marshall said the maximum amount of flood water to be provided for at long intervals would probably not exceed 10,000 cubic feet per second under present conditions. The average spring freshets probably did not exceed 3,000 cubic feet per second. The canal with its auxiliaries at Lockport and Joliet would safely pass this amount of water. The discharge over the dams above the mouth of the Kankakee was not likely to exceed 20,000 cubic feet per second. Such discharge was contemplated in the constructions and might be passed over the dams. There was no apparent reason why the constructions proposed would not satisfactorily meet the purposes of a navigable channel as far as the mouth of the Kankakee.

Below this point the conditions radically changed. The discharge of the Illinois river, which at low water below the mouth of the Kankakee and over the Marseilles dam did not exceed 1,000 cubic feet per second, including the supply by the Illinois and Michigan canal, increased at extreme floods until it reached 63,000 cubic feet per second at Marseilles. The draining of the Kankakee marshes in Indiana by a cut through the rock barrier at Momence would not lessen the ratio of 70 to 1 between flood and low water stage, nor

would the constant discharge into the Illinois river of from 300,000 to 600,000 cubic feet per minute by the city of Chicago for drainage purposes lessen the flood discharge, which determined the practicability of the route for all stages. The dams on that portion of the route were to be built as high as the topography of the valley would warrant without extensive permanent overflow of lands, or without materially increasing damage by floods, and the required depths secured by excavation. These dams had their crests from 8.5 to 18 feet or more below the high water plane, and at extreme flood stages would exercise no appreciable influence over the high water levels, slopes and velocities. The route would be navigable at all stages below a stage corresponding to a discharge of about 30,000 cubic feet per second, or under all ordinary conditions of the river, the extreme floods occurring at long intervals and being of short duration.

A route navigable at all times and in all conditions of the river could be obtained in four ways through the valley of the Illinois. By canaling past the reach between Lover's Leap and the foot of Marseilles canal, a distance of fourteen miles, for five miles above Marseilles dam and for three miles below the mouth of the Kankakee, practically in the bed of the river, with embankments above high water mark; by raising the dams, or by shortening the lengths of spillways until the sectional area of discharge throughout the pools was much greater than the area of discharge over the dams, converting the pools into reservoirs; by excavating and enlarging the cross sections of the pools until the same result was obtained, and by constructing a lateral canal throughout the line. Any of the first three methods would involve a greater expense than the fourth, or a continuous canal from Joliet to La Salle. The constructions proposed were considered to be adequate to create a navigable waterway in the bed of the Illinois river below the mouth of the

Kankakee at all ordinary stages of the Illinois river, but during floods the route might be found impracticable over the reaches named.

Although not instructed to do so Captain Marshall presented facts and discussed questions relating to the improvement of the Illinois river from La Salle to the Mississippi river. The lower Illinois, he said, was more like an estuary than a river. Its banks reached only to mid-stage, although not annually overflowed. Its slope was only .12 of a foot per mile. The bottom lands which were overflowed at stages above average high water varied in width from a few hundreds of feet to five miles, were generally covered with dense timber and cut up by numerous sloughs, lagoons and ponds. A large area of the higher part of the bottoms was cultivated before seeding when not submerged, and this cultivated area was annually increasing.

Throughout the valley of the Illinois it might be said in a general way, the engineer continued, that the bayous and lagoons began to fill at about the nine foot stage above the low water mark; at ten to eleven feet the lowest areas, worthless for cultivation, began to be submerged, and at about the twelve foot stage the overflow of useful areas began to be widespread. At about the sixteen foot stage probably eight-tenths of all lands submerged were covered with water. At La Salle, at the time of his report (February, 1890), low water was 4.4 feet above the original low water stage. Just below that point the overflow began to be appreciable at about the 7.7 or 8 foot stage above present low water. At Henry, Copperas Creek and La Grange the incipient overflow stage was reached at about the twelve foot stage above the low waters of 1871 and 1879. At this stage the discharge reached about 18,000 cubic feet per second at La Salle or Peru, about 30,000 cubic feet at La Grange and about 40,000 cubic feet (estimated) at Kamps-ville. The discharge producing overflow on the lower river

depended very much on the stage of the Mississippi river and the temporary slopes of the Illinois.

Below Marseilles, where the extreme flood discharge of the Illinois river was about 70,000 cubic feet per second, the river had many large tributaries and drained a much larger area than above it. The Fox river, the two Vermillions, Big Bureau creek, Sangamon river, Spoon river, Crooked creek, the Macoupin river and many others would probably swell its extreme flood discharge at its mouth to 120,000 to 150,000 cubic feet per second. The channel of the lower Illinois, without overflow, might not discharge one-third of its natural drainage at floods. The impracticability of the effort to prevent overflow by such methods as enlarging the channel of the lower Illinois by removing the dams and by dredging was, to Captain Marshall, apparent, since it required an increase to three times its capacity of a channel varying in width from 600 to 1,400 feet, fourteen feet deep and 225 miles in length. Besides, as he declared, the capacity of the channel could not be increased by the scour of the current over so gentle a slope as that of the river, the current at the utmost not exceeding three feet a second.

Concerning the effects of a definite increased discharge through the Illinois river on its channel depths, Captain Marshall said it would be desirable only during the low water stages. The natural low water volume of the Illinois river was gradually diminishing. Among the causes were the clearing of wooded areas, tile drainage and ditching. The rainfall was now sent rapidly into the river during the wet season of the year. Measurements seemed to indicate that the natural low water discharge from surface drainage alone of the Illinois river did not exceed 1,000 cubic feet per second within 79 miles of its mouth, after receiving the waters of nearly all its principal tributaries, the discharge of the Illinois and Michigan canal being about

700 cubic feet per second. The minimum discharge of the Illinois river after 300,000 cubic feet per minute had been added by the city of Chicago, it was assumed, would not exceed 6,000 cubic feet per second; after the addition of 600,000 cubic feet per minute it would not exceed 11,000 cubic feet per second. A discharge of 6,000 cubic feet per second would give a depth over bars in the unimproved river without dredging of at least 4.5 feet to La Grange, the depth diminishing to 3.8 feet at Kampsville, and probably not exceeding 3 feet over the lowest bar on the river. The discharge would not do away with the necessity for locks and dams for an ample channel or for channel works or dredging for a more restricted channel. The larger discharge would not do away with the necessity for dredging through bars to obtain seven feet at low water from La Grange lock to the Mississippi river, a distance of 79 miles.

Captain Marshall believed the dams on the Illinois river were necessary for navigation, by the aid of dredging, an average period of about two months in the year. Without the aid of dredging or channel improvements, and in the present condition of the bars on the lower Illinois river, with minimum depths of eighteen inches, the dams were necessary for longer periods.

As to the influence of the dams upon flood heights and flowage of lands Captain Marshall stated that all the dams on the Illinois river were drowned out before the overflow stage was reached; consequently, they had little or no influence in causing flowage of the bottom lands. None of them modified the currents at stages when the deterioration of rivers was usually a maximum, nor hindered in any way the scouring out of the pools above them at such stages of the river when the velocities were at a maximum and most effective. Movable dams would settle all disputes as to flowage damages at stages above low water.

Captain Marshall's plea for a navigable channel by way

of the Calumet river and the Sag instead of the Summit valley and the Chicago river is partially answered by himself. He admits that the latter would be the better route if the difficulties attending the navigation of the Chicago river were overcome, but abruptly assumes that this would be impossible,—an unwarranted assumption.

The argument alleging the inutility of a deep channel across the Chicago divide so long as the Illinois river is too shallow for the passage of large vessels, is also answered by the admission that the channel of the Illinois would be adequate, with a little systematic dredging, when supplied with a constant flow of water such as that proposed by the enlarged drainage channel.

It has been unwarrantably assumed by all the Government engineers that a navigable channel between Lake Michigan and the Mississippi river must necessarily be traversed by Mississippi river steamboats, and that vessels using the channel must necessarily navigate the Mississippi. At ordinary seasons the latter might be able to reach the Gulf of Mexico, but whether they could or not the commerce between the Mississippi and the lake demands the enlarged waterway.

Concerning a choice of routes at the Lake Michigan end for an enlarged navigable channel it is sufficient to say that it should communicate as directly as possible with the established business of the city of Chicago. To terminate the channel at the mouth of the Calumet river would necessitate an almost complete change in the location of the internal commerce of Chicago.

CHAPTER XXII.

BRIDGEPORT PUMPING WORKS.

When it was found necessary to abandon the deep cut in the construction of the Illinois and Michigan canal it was suggested that pumping works be erected at the head of the canal to supply it with water. The suggestion met with approval, and the pumping works were built and put in operation when the canal was opened in the spring of 1848. Although constructed for the sole purpose of supplying the canal with water to make it navigable, the city soon discovered that they were performing a very useful duty in cleansing the Chicago river. This led to an arrangement with the Canal Commissioners in 1865, by which the latter agreed to pump water from the river into the canal at certain times for the relief of the city from the serious annoyances of a badly contaminated river.

A heavy rainfall in that year kept the river in a comparatively clean condition. In 1886 the pumps were operated 62 days; in 1867, 150 days; in 1868, 73 days; and in 1869, 100 days. The amount of water raised by them in 1869 is estimated to have been 10,000 cubic feet per minute. The increase in the demands upon the pumps was due to a diminished rainfall, a lowering of the lake level and a greater pollution of the South branch of the river. The increasing business of the packing houses at Bridgeport was mainly responsible for the pollution. In 1860, 306,428 head of cattle and hogs were slaughtered, but in 1863 the number had increased to 1,029,948. The growth of the business and the consequent defilement of the

river continued from year to year. Soon after the completion of the deep cut in the canal in 1871, the packing-houses were removed from Bridgeport to the present location at the Stock Yards. The liquid refuse was then discharged into the South fork of the South branch, which soon became indescribably foul. This fork of the river, now a stagnant pond, the sickening contents of which overflowed into the South branch when it became full, has since remained the one plague spot within the city. In 1863 an epidemic of erysipelas occurred along the South branch, and was traced by physicians to the decaying animal matter in the river. This was one of the immediate causes of the appointment of the Commission in 1865 to devise a plan to cleanse the river.

When the deepening of the canal was accomplished, the pumps were thought to be of no further use. The condition of the river was greatly improved, and the city no longer solicited their aid. After two years of idleness the pumps were sold on June 25, 1873, for \$2,500. They had cost \$27,805.16. The remaining hydraulic property and adjoining lots were leased at a rental of \$2,500 a year.

It was not many years before the citizens deplored the fate of the pumps. A constant current was not maintained through the river from the lake, owing to fluctuations in the lake level, the direction of the wind, and other causes. The action of a southwest wind on the water of the Chicago harbor at one time resulted in lowering the water in the canal at Lockport, 27 miles away, fifteen inches. The rainfall had much to do with the amount of water which flowed from the river into the canal. In 1879 the current of the river was lakeward for thirty days, and for ten days there was no perceptible current either way. In 1873, for sixteen consecutive days, it is said that the average amount of water passing through the canal at Bridgeport was 33,000 cubic feet per minute. In 1879 the amount was estimated

to be only 17,000 cubic feet at any time and only 10,000 cubic feet in the winter when the canal was frozen over.

Dr. John H. Rauch, secretary of the State Board of Health, took up the question of the contamination of the water of the Illinois and Michigan canal in 1878 and 1879 in the interest of the people living in the valley of the Des-plaines, they having begun to make serious complaint. Under his direction daily observations were made by Samuel M. Thorp, locktender at Joliet, to determine the daily stage of water in the canal, the offensiveness of the odor arising from it, the general force and direction of the winds, the temperature and the degree of contamination of the water. Mr. Thorp's observations were begun on October 14, 1877, and continued to the end of November, 1878. During the winter of 1877 and 1878 an increase in the amount of sewage and the degree of the odor arising from it were observed whenever the water at the dam was low. As the amount of water increased the offense from the sewage diminished. During the period of Mr. Thorp's observations there were 249 days in which the water was filthy, and only 14 in which it was clear. On 117 days the odor was marked, on 116 days it was slight, and on 140 days there was no odor. On 211 days the water was low, and on 90 days it was high. These observations demonstrated to Dr. Rauch that a low stage of water was always attended by increased contamination and by an increase in the offensive odor and that the condition of the water was invariably improved in a marked degree even by an increase in the depth of the water by an inch or two. On September 30, 1878, following a low stage of water, the observer noted that all the fish in the river were killed, and on October 15, persons passing over the bridge were nauseated by the offensive odor. From the close of Mr. Thorp's observations until February, 1879, the odor escaping from the river at Joliet was so offensive that public meetings were

held and committees appointed to visit Chicago and demand relief. Dr. Rauch reports that during the fourteen months of Mr. Thorp's observations there was almost continued low water. Only once did the water rise fifteen inches above the low water mark and the average height above it did not exceed two inches. This indicated that the amount of water passing over the dam was diminishing, due to the lowering of the lake level 35 miles away.

Dr. Rauch concluded that the only remedy for the offensive condition of the canal and the Desplaines river would be found in an increased and constant flow of water from the lake into the canal. He suggested to the State Board of Health that it recommend to the city the rebuilding of the pumping works with the least possible delay. "This will be the first time," he said, "that the board has made a recommendation to the city of Chicago in relation to its sanitary affairs. There is another view of the case to which the attention of the municipal authorities of Chicago should be called, which is that the city has no right unnecessarily to injure the material and sanitary interests of any other part of the State. The community of interests which exists between the citizens of Chicago and the inhabitants of the country lying along the canal and river, forbids the injury of either by the other. It is but just to state that the plans heretofore adopted for the sewerage and drainage of the city of Chicago have been made with a view to such change as the future might require. The deepening of the canal, which was begun in 1865, was not completed until 1871, so that the relief afforded by that measure was delayed six years from the time when its necessity was recognized. The pumping works can be rebuilt in ninety days. My reasons for recommending this course are that the works will furnish almost immediate relief without great expense and without interfering with the project for a ship canal, or with any

more permanent plan which may become necessary for disposing of Chicago sewage."

The amount of water needed to cleanse the canal, Dr. Rauch said, was from 60,000 to 100,000 cubic feet per minute.

William Thomas, general superintendent of the Board of Canal Commissioners, at the close of the year 1879, called the attention of the Canal Commissioners to the condition of the Summit level. When the water was let into the deep cut the lake was more than three feet higher than it was in 1879. Navigation had been seriously interfered with. Either the bottom of the canal must be lowered throughout the entire length of the canal, he said, or more water must be supplied at Bridgeport. In his judgment it was a great mistake that the old hydraulic works at Bridgeport had not been preserved. With those works restored the water in the canal could be kept nearly as clean as that in the lake itself, and the navigation of the Summit level restored to its normal condition at an expense not to exceed \$75 a day. He thought the city of Chicago and the Canal Board should at once take steps to accomplish this purpose.

The recommendations of Dr. Rauch, fortified by the opinions of Mr. Thomas, were concurred in by the State Board of Health, and a copy of the secretary's report was transmitted to the Mayor and Common Council of the city of Chicago. The subject was earnestly discussed by the press, the Chicago Citizens' association and the Engineers' club. There were conferences between the State and city authorities and a convention was held at Ottawa to further the interests of a ship canal. The result was that the Common Council appropriated \$100,000 on March 29, 1880, for the construction of pumping works at the head of the Illinois and Michigan canal.

During the year 1880 the condition of the river continued to grow worse. In June Dr. Rauch made an exam-

ination of the Chicago river and found it more foul and offensive than it had been since the deep cut was completed in 1871. In the main river the current was toward the lake indicating little change in the level of the lake. At Van Buren street the water was almost stagnant. At Eighteenth street there was no current, and there was none at Halsted street for the first time within the secretary's recollection.

On July 19, 1880, a petition from the citizens of the city of Joliet was sent to the Canal Commissioners asking the privilege of digging ditches, without cost to the board, between the canal and the Desplaines river with a view to the purification of the waters of the canal. The petition follows:

“GENTLEMEN: -We, the undersigned, citizens of Joliet, Will county, and State of Illinois, would most respectfully petition your Honorable Body (for the reasons hereinafter mentioned) for the privilege of digging, constructing and making such ditches, flumes, races, and head-gates, without cost to your Board, between the Illinois and Michigan Canal and the Desplaines river, and along the line of the same from Lockport to Bridgeport, as will allow a sufficient quantity of water to pass from said river into said canal to feed the same, or so much of it as said river may be able to furnish.

“Your petitioners would most respectfully represent that for very much of the time during the last nine years, they have suffered to an extent beyond description from what they had supposed a nuisance caused by the city of Chicago cutting down the Summit Level of the Illinois and Michigan Canal, and turning its sewage matter, together with all other nastiness, from thence through the Chicago river into the canal. But having recently sent a committee of our business men to confer with the Mayor of Chicago, with reference to the proposed pumping works at Bridgeport, and,

however strange it may appear to others, having learned from his Honor that the water in the Chicago river was pure and clean enough for bathing and toilet purposes, and what was still stranger, that the nuisance complained of was not caused by the city of Chicago, but by your Honorable Board, that committee was instructed by his Honor to stir us up, to assist him in compelling your Honorable Board to abate the nuisance. And through his Honor, our committee was further informed that on account of the Fullerton avenue conduit and its pumping properties, the city of Chicago did not need the Bridgeport pumping works nor the Illinois and Michigan Canal itself; that the water that passed into the canal from the Chicago river was for the benefit of the canal and not for the benefit of the city.

“In view of all these facts (and facts they must be, or surely Mayor Harrison would not so advise us), we come to you and most earnestly pray your Honorable Body to not only allow us to make the openings mentioned above, but also that your Board would avail itself of its right to restore the dam at the south end of what was once known as Lane’s Lake, or head of Rock Creek, four miles northwest of Blue Island, and turn its waters back into the old Calumet feeder, and through it into the Illinois and Michigan Canal. By the assistance of these two sources of supply we are advised the water from the Chicago river can be entirely prevented from entering the canal for about eight months of the year, and in part for a longer period of the year, so that to a very great extent we shall be relieved from what is now an intolerable nuisance. Your petitioners would most respectfully urge your Honorable Body to give the subject that careful consideration which its importance demands, at the next monthly meeting of your Board, August 12th, next, to the end that we may get whatever relief is possible during this season.

“We have no doubt ample means can be obtained to do

this work from parties who own lands at the Summit, that are now nearly worthless, and which by means of this drainage will become very valuable. Each sluice or race to have ample gates to be closed against floods, and for a brief time at the beginning of winter to allow the ice-fields south of Summit to fill with water.

“All of which is respectfully submitted.”

At the close of the year 1880 the Canal Commissioners reported that the sewage of the city of Chicago in passing through the canal caused such an offensive smell as to become an almost intolerable nuisance to the citizens of Joliet and other towns along the line of the canal.

The State Legislature was now induced to use its influence and power in compelling the city of Chicago to divert its sewage from the Desplaines and Illinois valleys or dilute it with a larger discharge of water from the lake. A joint resolution was introduced in the senate by Senator Munn of Will county, which made these alarming statements :

The foulness of the water annually causes the death of millions of fish in the Desplaines and Illinois rivers, that float to the shores and decay. The sewage in an entirely undecomposed and putrid mass is carried by the current of the canal into the Desplaines river and thence into the Illinois river, rendering the air at all points along its passage so impure and foul as to be exceedingly offensive, and taking with it germs of disease of all kinds prevalent in the city of Chicago, thus spreading them broadcast through the entire Desplaines and Illinois river valleys, causing thereby much illness as well as poisoning the blood and debilitating the systems of 200,000 people. Careful investigation leads the people to fear that an epidemic may spread over said section of the state of Illinois from the causes above stated. In addition to the above distress there has been a great loss to property, business industries and to the communities by reason of the causes herein mentioned.

Prior to the deepening of the Illinois and Michigan canal the water necessary for all purposes of navigating the canal and propelling machinery was obtained from the Desplaines river and the Calumet feeder through Lane's lake. The bed of the Desplaines river at Summit and thence westward along the line of and adjacent to the canal is at a low stage of water eight above the surface level of the canal and will average a supply of water sufficient for all canal and power purposes during the seasons of navigation. The supplying of the canal from these sources will so dilute and weaken the sewage of the city of Chicago as greatly to relieve it of its foulness and stench, to the great delight, relief and health of the people near to and bordering upon the line of the canal, the Desplaines and Illinois rivers.

Following this preamble was a resolution directing the Canal Commissioners to cause sluiceways of sufficient capacity, with the proper guard gates, to be opened from the Desplaines river to the canal at or near the Summit in Cook county, and at or near Lemont in Cook county, and also to construct a dam across the former Calumet feeder at such suitable point as would cause the water from Lane's Lake to flow into the canal. The commissioners were required to commence this work immediately, the cost not to exceed \$10,000.

This bold attempt to coerce Chicago into disposing of its sewage by some other method than discharging it into the Illinois and Michigan canal met with determined opposition on the part of Chicago, and several provisos were added to the resolution which gave the city the benefit of an alternative. The provisos authorized the Canal Commissioners to confer with the Mayor of the city of Chicago, or authorities of the city, concerning an increased flow of water into the canal. If the city should proceed without delay to cause a flow into the canal from the Chicago river sufficient to dilute and purify the waters and thus remedy the evils complained

of, such flow to be not less than 60,000 cubic feet per minute, including the ordinary flow into the canal from the river, the work to be accomplished by the 1st day of September, 1881, the Commissioners were directed to accept it in lieu of obtaining a supply from the other sources named. The Commissioners were required to take care of 60,000 cubic feet of water per minute, but the State was not to be committed to a system of permanent drainage of Chicago sewage through either the canal or the Desplaines or Illinois rivers, the State reserving the right to require the city of Chicago in future years to take care of its sewage through other channels. The city was also required to maintain and manage the pumping works, subject to the direction of the canal commissioners relative to the amount of water to be received into the canal.

The resolution, as amended, was adopted by the Senate on May 18, 1881, and by the House on the following day.

In the meantime specifications had been framed and proposals asked for throughout the United States, Canada and England for the construction of pumping machinery to deliver 60,000 cubic feet of water per minute from the Chicago river into the canal. Bids were opened on October 18, 1880, and were found to range from \$125,000 to \$275,000 for the machinery alone; the canal lock, machinery foundations, building, etc., would cost about \$50,000 additional. As \$100,000 only had been appropriated the bids were all rejected. An additional appropriation was made by the Common Council in March, 1881, and the contract for the construction of the pumps was awarded to N. F. Palmer & Co., of New York, on August 21, 1881. The work was to be completed July 1, 1882. It was not finished and the pumps set to work until June 3, 1884. The pumps cost \$251,177.22. The works were located on the south bank of the canal at the junction of the canal and the South fork of the South branch of the river. The construction of a lock

and dam to prevent the return flow of the water was included in the cost of the works.

The machinery consisted of four sets of centrifugal pumps placed in a dry well below the surface of the water in the river, and driven directly by a vertical condensing compound engine. The pump wheels were six feet in diameter, and made of cast iron. Each pump was furnished with separate supply and discharge pipes, which were three feet and four inches in diameter at the pump and increased rapidly to four feet and six inches at the outlet. Each pump was coupled direct to the engine crank shaft. There were eight horizontal return tubular boilers, each six feet and six inches in diameter and eighteen feet in length. In the test trial the pumps delivered 49,587 cubic feet of water per minute at a head of 6.489 feet, which, measured from datum, would have been 7.622 feet. This did not meet the requirements of the contract, and the pumps were practically rebuilt during the next year. The blades were changed in shape, and the size of the inlet increased. A subsequent test showed that the pumps were able to raise the requisite amount of 60,000 cubic feet per minute eight feet high.

The cost of operating the pumping works for the year 1885 was \$44,644.07. The expense was reduced to \$39,618.91 in 1888, but in 1891 it had increased to \$72,802.42. In recent years repairs have been repeatedly necessary.

At the time of the tests the lake level was at an average high stage, and the conditions were favorable to the pumps. Both river and canal were kept in a comparatively in-offensive condition for two years. In 1886 the average mean level of the lake below datum was 2.64 feet. In the following year it dropped to 1.96, and continued to fall until it reached 0.05 feet above datum in 1891. With the lowering of the lake level the pumps were required to raise

the water at the head of the canal through a greater distance, and the result was a less amount pumped. The required 60,000 cubic feet per minute was reduced to an average of 37,771 cubic feet during the year 1891. With little more than half the required amount of water pumped from the river, and the sewage discharge into the river greatly increased because of the rapid growth of the city, the river and the canal again became very foul and offensive. But the city of Chicago had complied with the requirements of the law of 1881, and the Canal Commissioners did not make the cuttings from the Desplaines and Calumet rivers which the people of the valley demanded. Had they done so the outlet for Chicago sewage toward the interior of the State and the Mississippi river would have been cut off, and Chicago would have suffered immeasurably. The resulting contamination of the city's water supply would have depopulated the city.

The following table shows the height of the water of Lake Michigan above datum from 1854 to 1891, inclusive:

Table Showing Maximum, Minimum and Mean Water in Lake Michigan Annually from 1854 to 1891, both inclusive.

Year.	Max.	Min.	Mean.	Year.	Max.	Min.	Mean.
1854.....	-----	-----	1.83	1873.....	2.70	-0.76	1.40
1855.....	3.45	0.15	1.56	1874.....	2.80	-0.20	1.67
1856.....	3.05	0.42	1.60	1875.....	3.01	-0.34	1.45
1857.....	4.35	0.60	2.42	1876.....	4.31	0.34	2.56
1858.....	4.69	1.33	2.	1877.....	3.56	1.04	2.31
1859.....	4.45	1.31	2.98	1878.....	3.14	0.51	2.00
1860.....	3.53	1.30	2.54	1879.....	2.51	-0.49	1.06
1861.....	4.40	1.20	2.56	1880.....	2.81	-0.99	1.16
1862.....	3.30	0.70	2.50	1881.....	3.01	-2.19	1.26
1863.....	3.30	-0.80	2.10	1882.....	3.01	-0.99	2.00
1864.....	2.80	-0.40	1.57	1883.....	3.81	-0.99	2.10
1865.....	3.66	-1.08	1.30	1884.....	3.31	-0.01	2.24
1866.....	2.50	0.00	1.07	1885.....	3.71	-0.01	2.48
1867.....	2.60	-0.41	1.49	1886.....	4.41	0.01	2.64
1868.....	2.58	-1.00	1.01	1887.....	3.11	0.01	1.96
1869.....	2.13	0.41	1.13	1888.....	3.01	0.01	1.30
1870.....	3.25	-0.30	2.09	1889.....	2.51	-0.79	0.77
1871.....	2.80	-0.40	1.77	1890.....	2.21	-0.99	0.63
1872.....	1.80	-0.74	0.81	1891.....	1.61	-2.39	0.05

The level of the water of Lake Michigan in 1891 was the lowest in the history of the city of Chicago. It was below datum for 130 days, and at no time during the year was it more than six inches above datum.

Chicago datum was established by the Illinois and Michigan Canal Commissioners in 1847, and represents the level of low water in Lake Michigan in that year. It has since been used as a basis for fixing water levels in the vicinity of Chicago.

CHAPTER XXIII.

OGDEN-WENTWORTH CANAL.

Before the deepening of the Illinois and Michigan canal in 1871 the low and swampy land lying east of Summit and north of the canal was covered with water during the greater portion of the year. This territory included several hundred acres and constituted what was known as Mud lake. It extended eastward from Summit about three miles and northward nearly to the West fork of the South branch of the Chicago river. Its surface was below the level of the water in the canal, but several feet higher than that of the Chicago river. The latter condition suggested to the owners of the swamp property the feasibility of reclaiming it by dredging an outlet to the Chicago river. It was also proposed to improve other low-lying lands in the vicinity in the same manner. Ditches were dug in both directions from the East fork of the South branch, some of them connecting with Mud lake. But the latter were not effective until the completion of the deep cut in the canal, because the lake was filled with seepage from the lake as rapidly as it was drained through the ditches.

The good effects of the ditches encouraged the owners of property lying along the banks of the Desplaines north of Summit to carry the channel of the West fork farther westward and at the same time deepen it for an improved navigation and dockage. The owners of this property were William B. Ogden, the first mayor of Chicago, and John Wentworth, mayor of the city at a later date. A channel was dug which has since been known as the Ogden-Went-

worth canal, or ditch. It has played an important part in obstructing the efforts of Chicago to maintain an uncontaminated water supply and thus acquired an unenviable notoriety.

Work on this canal was begun in the year 1871. A dredge was constructed on the banks of the Desplaines river and launched about one mile north of Summit where excavation was commenced. Dredging was continued in an easterly direction until a connection was made with the West fork. The canal was about twenty feet wide at the top and the depth slightly below the bed of the Desplaines river. When the floods came in the spring and summer of 1872 the rush of waters from the Desplaines, now sweeping toward the Chicago river, accomplished what the projectors anticipated and their canal was greatly enlarged. Within a short time there was a very troublesome stream flowing eastward from the Summit into Lake Michigan instead of down the valley of the Desplaines. The Desplaines river was practically diverted from its old channel.

The results were most unfortunate. The city had spent millions of dollars in enlarging the Illinois and Michigan canal for the purpose of discharging the Chicago river and the sewage of the city into the rivers of the valley. Now the current westward was counteracted by the new flow through a ditch which was constructed for the benefit of private interests. Relief was no sooner secured than it was taken away. During the winter and spring of 1872-3 the city authorities observed that the Chicago river was no longer cleansed by the usual flow of water into the Illinois and Michigan canal. An investigation revealed the fact that the Chicago river was remarkably low and the ice in the canal twenty-two inches thick, reducing the outward flow very greatly. Continuing the investigation the authorities also found that the Ogden-Wentworth canal was supplying the West fork with about all the water that the canal

could carry, the canal entering the West fork near the latter's junction with the South branch of the river. The pumps were unable to draw any water from the South branch. Without any current in its channel the river became increasingly foul.

The attention of the Canal Commissioners was directed to the circumstances, but they did not consider it an affair of theirs, and took no action to remedy the evil. They discovered in the following winter that the canal had been seriously injured by the inflow from the Ogden-Wentworth canal. That winter was a wet and warm one. Boats were able to navigate the Illinois and Michigan canal from Chicago to Lockport during every month of the winter. In the latter part of the season it was noticed that shoals were forming in the canal, even as far south as Lockport. The canal was closed and the water drawn off. The Commissioners were surprised to find that earth in large quantities, evidently from Riverside, Mud Lake and Cicero, had been deposited in the canal from a point about one mile east of the lock at Lockport to or near dam No. 1 at Joliet. The soil had been carried into the Ogden-Wentworth canal by the numerous ditches which had been dug for draining the country. The current in the Ogden-Wentworth canal had been strong enough to sweep it all into the Chicago river, to be drawn by the pumps into the Illinois and Michigan canal. The force of the current in the Ogden-Wentworth canal was that of a stream with a capacity of 15,000 to 20,000 cubic feet per minute in a channel twenty feet wide at the top, and a descent of about nine feet in its course of five miles from the Desplaines to the Chicago river. William Thomas, superintendent of the Illinois and Michigan canal, reported that it would be necessary to remove 50,000 cubic yards of material, which had been washed in from the Ogden-Wentworth canal, from the Lockport end of the Summit division of the Illinois

and Michigan canal. He declared that the entire flow of the Desplaines river had been turned from its natural course north of Summit to and through Mud Lake and the West fork of the South branch of the Chicago river into the Illinois and Michigan canal.

The Board of Public Works of the city of Chicago became apprehensive of possible evils when the effects on the canal were disclosed, and recommended to the Common Council that steps be taken to avoid them. "The condition of the water in the West and South forks of the South branch admonishes," they said, "that some plan must very soon be adopted for the purification of these portions of the river." But they made no specific recommendations.

In the spring of 1874 City Engineer Chesbrough suggested the construction of a dam with sluice-gates in the Ogden-Wentworth canal near the Desplaines river which would prevent water passing from the river into the ditch whenever it would be injurious to the city. He recommended a compromise with the owners of the ditch by which this improvement could be effected. "Such an arrangement might be advantageous to both parties," he said. "There are times, generally of short duration, when a moderate current from the Desplaines into the South branch is decidedly beneficial, because at such times there is naturally a current into the lake, and the stronger that current within certain limits the better. Again there are times when the natural current in the South branch is so strong as to deepen the channel more or less. March 12, 1849, this current was so strong as to carry away shipping and bridges, and flood a part of the city. To be able, at such times, to control the direction which a large part of the Desplaines water would take would be of great service and might avert great disaster. Unfortunately any current in the canal sufficiently strong to produce or aid materially in producing a scouring effect in the South branch and main

river, brings from the ditch into the upper part of the South branch a large amount of silt, which is deposited in the river, and into the mouth of the docks there, and has to be dredged out again at a very heavy expense. The problem in all its bearings is intricate and difficult, but it is very clear that the city is now exposed to greater damage and disaster than it was before the opening of the ditch, and that to a considerable extent at least this damage might be prevented by moderately expensive works if the parties interested could agree in relation to them."

The Board of Public Works understood to what an extent the ditch was an annoyance and a source of danger, but they were opposed to any action which committed them to a recognition of the right of individuals to impede or damage a municipal waterway. They were clearly of the opinion that the city had a right to protect the usefulness of the Illinois and Michigan canal.

Nevertheless an agreement was made between the municipal authorities of Chicago and the owners of the ditch that an embankment with head gates should be thrown across the bayou through which the water ran from the Desplaines river to the Ogden-Wentworth canal. The height of the embankment was to be sufficient to prevent overflow. The work was to be placed under the control of the city authorities.

Claims for prospective damages and resulting legal complications delayed the construction of the embankment and dam and they were not completed until June, 1877. The dam was located on the east line of section 12, township 38, range II, 1,150 feet south of the northeast corner of the section, where the line crosses an arm of the Desplaines river with which the Ogden-Wentworth canal was connected. It was of a temporary nature, constructed of a row of sheet piling supported on the lower side with round timber piles and filled on the upper side with

earth. The top of the dam was 11.8 feet above city datum. City Engineer Chesbrough reported at the close of the year 1877 that "during the greater part of the time no water flows over its top; hence the water from the Desplaines river is excluded from the Chicago river during the season of the year when its presence is seriously objectionable."

The Illinois and Michigan canal still suffered grievously from the Ogden-Wentworth canal. In his report for the year 1877 Superintendent Thomas called attention to the "abominable outrage committed upon the public property." He said that \$75,000 would not make the State good for the damage done the canal "by this nuisance." He added: "The authorities of the city of Chicago, or some other parties, have constructed a dam across this ditch the past season which is two feet lower than the natural banks of the river, and there is now six inches of water flowing over it. The dam is about fifty feet long, and the water which passes over it runs rapidly down through a narrow channel, taking with it the soft vegetable mould or mud of the swamp land, and deposits large portions of it in the canal at Lockport, amounting to half an inch every twenty-four hours during a considerable portion of the year. In some places where I had dredged last year and left eight feet of water, we found less than four feet when we commenced dredging this season. The cost of dredging at the Lockport end of the Summit level and in the first level below has been \$6,483.94, making a grand total of expense for this year chargeable to the Ogden-Wentworth ditch of \$16,475.94.

"The deposits from this ditch do not all stop at the Lockport end of the Summit level. The next level below is so filled up that it is difficult for boats to meet and pass. In the upper part of the canal above dam No. 1 at Joliet, and in the channel of the canal in front of the Penitentiary dock, it is so filled up that loaded boats cannot land. In this part

of the canal, where the water used to be eleven feet deep, it is not now over three feet, and for two miles below Joliet heavy deposits are being made."

Confining the water of the Desplaines river to its channel by the dike which had been constructed across the low-lying ground north of the Ogden-Wentworth ditch had caused it to overflow its banks below Summit and wash large quantities of earth into the Illinois and Michigan canal. There were five or six breaks into the canal between Summit and Lemont. At Willow Springs and Mount Forest the breaks were said to be very serious, each being from 100 to 300 feet in width and in some places to the full depth of the canal. At Mount Forest the prism of the canal was entirely filled with sand and other material. It cost the State \$9,992 to clean out the channel and repair the banks, and the opening of navigation the following spring was considerably delayed.

The dam across the Ogden-Wentworth ditch became so dilapidated that it was rebuilt in 1885, but its height was not changed. The dam now consisted of substantial wide cribs filled with stone. Water continued to flow over its crest when the Desplaines river was high, resulting in the usual contamination of the water supply of the city and damage to the Illinois and Michigan canal. Commissioner of Public Works DeWitt C. Cregier, recommended that the dam should be raised to a height of fifteen feet and extended from the elevated lands north of the banks of the Illinois and Michigan canal south, a distance of about 1,700 feet. "The structure should be broad enough at the top," he said, "to form a public highway, an improvement greatly needed in the locality, and be provided with a number of sluice-gates to admit of the necessary flow of water required to keep the West branch of the river in good condition, and at the same time permit the full capacity of the pumping works to act upon the water and sewage in the



DESPLAINES RIVER SPITWAY NORTH OF SUMMIT

South branch." He admitted that a dam of the proportions suggested would be costly and that it would cause considerable damage to adjacent lands by overflow. This would probably render its construction inexpedient. Therefore, until the Illinois and Michigan canal could be enlarged, or some better plan devised to carry off the sewage entering the river and the disposal of the filth in the South fork, there would be times when the river for brief periods would become foul and objectionable. Mr. Cregier's solicitation was mild as the results of the next few years proved.

The city has spent an approximate average of \$1,000 a year for the maintenance of the dam since the date of Mr. Cregier's recommendation and has done nothing toward an enlargement of the structure. During the year 1891, \$3,424.42 was spent in extensive repairs. The ditch has become a constantly flowing stream, serving a useful purpose in draining adjacent lands, but causing the usual damage when the Desplaines river is at flood heights.

CHAPTER XXIV.

FULLERTON AVENUE CONDUIT.

In the original plans of the city's sewerage system, it was foreseen that the Chicago river and its branches would sooner or later become sources of great annoyance unless artificial means were taken to maintain a circulation through it. The main river and the South branch depended to a certain extent upon the Illinois and Michigan canal. The North branch had no such auxiliary. City Engineer Chesbrough, who planned the city's sewers, hoped, as he said in his report for the year ending March 31, 1870, that by arranging the system so that but very little filth would be discharged into the North branch it might be many years before it would be necessary to construct any expensive works to purify it.

But this branch of the river became foul much earlier than was expected. Up to the year 1870 less than 5 per cent of the sewage of the city is said to have been discharged into the North branch, but it received the waste from distilleries and tanneries erected along its banks. It became so offensive that the State Board of Health was called upon to enforce the State law against the maintenance of nuisances. The Board's action brought some relief, but the condition became so serious that the Board of Public Works was of the opinion in 1870 that it was not wise nor safe to postpone further "entering upon some efficient plan for keeping clean the North branch."

City Engineer Chesbrough recommended in that year that a covered canal, or conduit, be constructed along

Fullerton avenue between the North branch and the lake. A summary of his discussion of this subject is given in Chapter VI. The Board of Public Works agreed that "for flushing out the river but one of the many schemes proposed seems to them to promise to be effectual and worthy of adoption, that is, the construction of a canal, open or covered, between the lake and the North branch, through which the water shall be forced by mechanical means, either into the river or into the lake, as shall at the time be necessary."

In September, 1872, the artesian well scheme for flushing the North branch was proposed and rejected. Still another year was spent in a discussion of other possible means of purifying the increasingly offensive stream. It was finally decided to construct the conduit, and proposals were advertised for three times. The contract was ultimately awarded to George F. Norris & Co., under proposals opened on March 31, 1874, at \$343,284. The work was to be completed on July 1, 1875. The conduit was to be circular in shape, twelve feet in interior diameter, the invert at a grade of thirteen feet below datum, and extend from the North branch of the Chicago river along Fullerton avenue to Lake Michigan.

Excavation was begun about the first of June, 1874, at Ashland and Fullerton avenues. The work was carried on in both directions until December 8, when it was discontinued. About 4,000 feet had been constructed. The contractors found, as they claimed, that the character of the work had been misrepresented, and that their price was too low. The Board of Public Works resisted their claim for an increase of price, but a settlement was effected on June 14, 1875, and the contractors were released. New proposals were received on July 26, and the contract for the completion of the work was awarded to FitzSimons & Connell. The contractors were given the option of doing the work in

open excavation or by tunneling at a lower grade. This contract was concluded on September 13, and work was resumed on October 28. Shafts were sunk at the lake shore, Larrabee street and at Sheffield avenue. West of Racine avenue the excavation was an open cut; east of that point, a tunnel.

The conduit was completed and the machinery put in operation on January 9, 1880. It was a brick tunnel twelve feet in diameter and 11,898 feet in length. The bottom of the tunnel from the river to Racine avenue, a distance of 4,270 feet was level, and thirteen feet below datum. A short distance east of Racine avenue it dropped to a grade beginning at a depth of $27\frac{3}{8}$ feet below datum. It was continued in a series of descending grades to the lake shore shaft where it was $54\frac{1}{2}$ feet below datum. From this point to the lake shaft, 1,000 feet in length, the conduit was level. The change in the grade was made for convenience in excavation.

The upper part of the lake shaft was a cast iron cylinder, 14 feet and $2\frac{1}{2}$ inches external diameter, and 24 feet high. It was lined with brick, reducing the internal diameter to 12 feet. The shaft below the cylinder was also 12 feet in diameter. The top of the cylinder was $4\frac{1}{2}$ feet below city datum, and was within a wooden chamber whose internal dimensions were 34 by 18 feet, with openings on the east side into the lake. The openings were fitted with gates, which were intended to be closed only when the cover was on the shaft, and to prevent the lifting of the shaft by the waves. The water was shut off from the conduit at the lake shaft by a conical cover of boiler plate. The shaft was protected from the action of the waves and ice by a pier of pile work braced together and filled at the ends to the level of the water with loose stones or rip-rap. On the pier and over the shaft was a frame house in which there was a winch for raising or lowering the covering of the shaft.

The shore shafts were carried up to the level of the street and domed over with openings, and there were ladders for means of access to the conduit. At the river end where the machinery was located, the conduit was divided into two semi-circular channels between which was a wrought iron chamber. Passing the chamber, the two channels were again merged into one and led into the river. The outlet was protected by a heavy masonry dock wall, in which there was a screen of iron rods to keep floating debris out of the tunnel.

Water was forced through the conduit by two screws, similar to those of an ordinary propeller, attached to the ends of a horizontal shaft forty feet in length, placed in the center line of the conduit. This shaft passed through the boat-shaped iron chamber, between the branches of the conduit near the river, ten feet in its greatest diameter. The shaft and screws were operated by two marine engines. They could be reversed at will, and the water driven through the conduit in either direction. The screws were four bladed, and six feet and seven inches in diameter. The machinery was designed to work at a uniform rate of 100 revolutions per minute, but was capable of making 125 revolutions without injury. That portion of the conduit surrounding the shaft chamber, 64 feet in length, was lined with a circular timber lining, funnel shaped at the ends. At each end the inside diameter of the lining was 12 feet. It was gradually contracted toward the center, and at the screws it was six feet and eight inches, one inch greater than the diameter of the screws.

The gates measured 12 feet across the opening, and were made of boiler plate faced with brass. In the center of each gate there was a supplementary gate, 36 inches in diameter, to relieve the pressure on the larger gate when required. To ascertain the head of water against the screws there were two walls connected with the conduit

by a four-inch pipe. The capacity of the conduit with one hundred revolutions of the screws was 24,000 cubic feet per minute. The cost of the conduit, including engines, boilers, building, river connections, dock, etc., was \$564,253.99.

When the conduit was opened the pumps were operated to draw water from the lake into the river. Other circumstances favored the cleansing of the North branch. There was a heavy rainfall and long continued high winds from the northeast, which helped to drive the water in the main river up the South branch, thus aiding the Bridgeport pumps to do their work. So long as the pumping from the lake into the river through the Fullerton avenue conduit was continued the North branch was kept in a cleanly condition, and the conduit was pronounced a success. The condition of the main river and its branches in the year 1880, with other facts relating to the drainage and sewerage of the city, is shown by the following tabular statement:

FULLERTON AVENUE CONDUIT.

Condition of the River and Extent of the Sewerage of the City in 1880.

NAME.	Area of surface in acres draining into each branch.	No. sewers discharging into each branch.	Aggregate area of their terminal openings in square feet.	Condition of the water in each division of the river.	Relative density of population on each of the given areas.
North Branch	1988.98	19	229.53	{ From rolling mill north comparative-ly pure; from same point south highly discolored, with little odor. }	$\frac{2}{3}$ densely, $\frac{1}{3}$ sparsely settled.
Main River	808.08	16	122.47	{ Nearly free from deleterious matter, little or no odor. }	Densely settled.
South Branch	3364.09	48	460.05	Highly discolored, with very little odor	$\frac{2}{3}$ densely, $\frac{1}{6}$ sparsely settled.
West Fork of South Branch --	581.73	2	56.94	No perceptible odor, water nearly pure	Sparsely settled.
South Fork of South Branch...	354.45	5	52.82	{ Extremely foul, water charged with decomposing animal and vegetable matter, odor very offensive. }	Sparsely settled.
	7097.33	90	921.81		

That portion of the South division of the city which drains directly into the lake contained 1,270.43 acres, making a total area of 8,368 acres covered by the sewer system of the city in 1880, a little more than 36 per cent of the entire area of the city.

The conduit pumps were operated irregularly during the first year, and by the aid of the rains and winds the North branch was kept in a comparatively inoffensive condition. In the following year the pumping was mainly from the river into the lake. Occasionally when the current of the river north of the pumping works was so strong that the pumps had little effect upon it the pumps were reversed. When the current was toward the lake the offense of the North branch was transferred to the lake shore, in a less degree, and the city's water supply was often contaminated by distillery refuse and sewage.

New wheels eight feet in diameter were put in during May and June, 1882, increasing the power and efficiency of the works. City Engineer Artingstall made these statements in his report covering that year :

"The greater part of the year the water has been discharged from the river into the lake with good results, maintaining during such times the North branch and the main river in an excellent condition, free from offensive odors and the water comparatively clear. Twice during the year the experiment was made, for extended periods, of pumping from the lake into the river. During both times the water in the main branch became foul and very offensive."

The people differed from Mr. Artingstall as to the effects of the water pumped from the North branch into the lake and vice versa, and such protests were made against pumping into the lake that it was done only occasionally. It was entirely discontinued in 1885. While the North branch has been greatly improved by the conduit pumps, it has been

very offensive in recent years due to the increase of the sewage discharge into it and the number of factories and other refuse producing operations on its banks.

The pumps have fallen considerably short of their original requirements, the average amount of water pumped per day during the year 1891 being 15,000,000 cubic feet. This was about 10,416 cubic feet per minute. The conduit has a capacity of about 24,000 cubic feet per minute.

CHAPTER XXV.

WORK OF THE CHICAGO CITIZENS' ASSOCIATION.

Much was done by the Citizens' Association of Chicago between the years 1880 and 1889 in creating and fostering a public sentiment which demanded better drainage for the city. Several expert examinations were made by the association and its reports were given to the people through the daily papers and printed pamphlets. These investigations and the resulting discussions led to the more exact and complete investigation by the Drainage Commission under the authority of the municipality. Although the suggestions of the association were not always practical, they kept the people thinking, a very useful preliminary to public legislation.

The association referred the subject of main drainage for the city of Chicago to a committee in the year 1880 with a request that it recommend some system for the disposal of the sewage of the city which should be adequate for present and future needs. The committee consisted of John B. Sherman, George C. Morgan and S. B. Reed. In the course of its investigations the committee employed A. J. Mathewson, a civil engineer of Joliet, to make surveys and estimates. The results of the committee's inquiries were given to the association in a report made in December, 1880, which was endorsed by the association.

Suggestions from citizens were invited and given consideration by the committee. One of these, which had the endorsement of "high authority," proposed the erection of works similar to those of the Fullerton avenue conduit at

the south end of the South branch, to pump water either from the lake into the river, or flush the river by reversing the process and drawing the water of the main river through the South branch. This, the committee thought, would be effective within a fixed limit, but it did not answer the question of a general and permanent disposal of the city's sewage. Among the objections were the expense of pumping and the discharge of filth into the lake.

Another and more feasible scheme was the construction of intercepting sewers, one on either side of the Chicago river, which should deliver the sewage at some point outside the city. Once out of harm's way it could be utilized, it was thought, on waste land or discharged into the lake.

Another plan, and one partially sanctioned by the committee, was to construct a canal in the rear of the city to receive both surface drainage and the contents of the Chicago river. This canal would discharge into the Desplaines river near Joliet. The territory to be drained was a district which embraced the entire valley of the Chicago river, a territory from seven to ten miles in width and forty miles long. The Fullerton avenue conduit would aid in disposing of the sewage of the portion of the city which it traversed. The sewers in the North and South divisions of the city, not otherwise provided for, were to be discharged into the lake.

Objections to these plans were found in the original and continually increasing expense and because they required a discharge of all or a portion of the sewage into the lake. "Our objections to any plan," the committee said, "which suggests the discharge of sewage or impure matter into the lake, where they could in any event contaminate the water supply, are so fixed that part of the recommendation in the plan we shall hereafter propose is that a radical change in the whole system of sewerage in the North and South divisions shall be inaugurated by which all sewers shall empty into the river. Although we have given careful considera-

tion to all plans laid before us we make no reference to any except those mentioned above, which propose the use of the lake for the ultimate disposition of the sewage."

The committee thought it proper to remark in this connection that the filthy water discharged from the Fullerton avenue conduit, when it was operated in the direction of the lake, could be traced for a long distance in the direction of the water works crib. To attempt to get the water supply from a more distant point, either out in the lake or toward the north would be only a partial remedy. Besides, the cost would be more than that of a permanent and wholly satisfactory plan for the disposal of the sewage. It was suggested to the committee that the locks and dams in the Illinois and Michigan canal might be removed when the water from the Chicago river would flow freely through it. To this the answer was given that the usefulness of the canal commercially would be destroyed, private interests seriously affected and a deepening of the canal necessitated.

The considerations of the committee were finally narrowed down to two propositions. One of these involved the construction of a ship canal, which seemed to have the sanction of public opinion. "We have given a large share of our attention to this scheme," the committee said, "with little knowledge of the methods of sewage purification, and although we are unanimously and cordially in favor of a ship canal as such, we cannot give it the sanction of our favorable opinion as a drain. As such it would be liable to all the objections now urged against the present canal, as to its annoyance of the inhabitants along its banks for the reason that any current which would move the water with sufficient velocity to prevent the deposit of filth would impair its usefulness for commercial purposes, it having been well ascertained that no current greater than half a mile per hour is tolerable in slack water navigation. The project for such a canal is embarrassed also with many con-

siderations of a political nature, which we do not deem it within our province to consider, preferring to present the other plan, which can be carried out within a reasonable time at a very moderate cost, and which is wholly within the scope of the pecuniary means of those for whose benefit it will have been constructed, and will, it is believed, be wholly devoid of offense to any locality or people."

The plan as revised and approved by the committee provided for the construction of a canal, or "New river," which is described by Engineer Mathewson as starting "from the mouth of the Regula, or Mud Lake fork of the South branch of the Chicago river, running off west and through said lake toward the Desplaines river north of Summit, and then curving round to the left, keeping away to the left, and passing along in a southwest direction between the canal and the river, past the ice houses and between said houses and the river to Mount Forest, Willow Springs, Sag Bridge station and Lemont to the Romeo bend of the canal, Norton's tail race at Lockport, and to a point opposite lock No. 1 at Lockport; thence to a point at the head of the pond of dam No. 1, Joliet, a few hundred feet northwest of lock No. 4 of the Illinois and Michigan canal, a distance of not far from 31½ miles."

The committee thought this plan sufficient for the drainage of Chicago for all time to come. To complete it the sewers discharging into the lake would need to be reversed and made to discharge into the Chicago river, as well as local drains as far north as the source of the Chicago river and south in Hyde Park. The towns of Lake and Cicero would also come within the limits of the drainage district proposed. In reversing the city sewers such fall should be given to them that they would be self-cleansing. The Fullerton avenue conduit could be used for the purpose for which it was constructed, or it could be converted into a useful adjunct of the city's water supply system. The

forks and branches of the Chicago river at the south end would purify themselves, as their contents would gravitate toward the new cut in the Desplaines valley. The current in the New river would be at the rate of 2.15 miles per hour. The water in the Chicago river would be changed every twenty-four hours, and the water of the entire Chicago river would become as pure as that of the lake, and remain so. The effect upon the waters at the point of discharge would be to improve them greatly.

To carry this project into effect would require State legislation creating a drainage district and a commission to carry out the provisions of the law. The estimated cost of the New river was \$6,850,000, but it was thought the sum of \$12,000,000 would be necessary to develop the scheme in all its necessary details. Commissioners should be authorized to borrow money on the credit of the district. A loan for the purposes required, it was thought, if redeemable in thirty years, would be readily taken at 4 per cent. At a low assessed valuation of the property of the district a tax of two mills would be sufficient to pay the interest and provide a sinking fund for the principal.

The importance of this report is found in the fact that it suggested the idea which developed into the law of 1889 creating the Sanitary District and providing for the drainage channel.

On August 27, 1885, another committee made a report on the question of the main drainage and water supply of Chicago. This committee was composed of Ossian Guthrie, Lyman E. Cooley, F. W. Reilly, William Rutherford, Charles A. McDonald, David Bradley, J. J. Glessner and Edwin Lee Brown. Among the specific questions discussed by the committee was the pollution of the water supply, the evidence of which was substantiated by examinations made by B. W. Thomas, microscopist, and M. Delafontaine, chemist. The testimony of these experts, in the opinion of

the committee, confirmed the general belief that the water of Lake Michigan in its natural condition was perfectly satisfactory, "and that no alarm need be felt for the ultimate satisfactory solution of the water question, except through neglect or incapacity." But the committee was also of the opinion that the water supply of the city was frequently, and during "considerable" periods of time, dangerously contaminated. "That the river water and sewage have, on several different occasions, since the second day of August last, reached the crib in an unbroken flow," the committee said, "admits of no possible doubt. River water and sewage in a partially diluted state have surrounded the crib during nearly the entire time covered by the investigations of your committee."

The condition of the North branch and the operations of the Fullerton avenue conduit received the attention of the committee. Serious objection to the operation of the conduit in the direction from the river to the lake was expressed; at times of flood discharge the pumps should be stopped entirely, the committee said. The flood discharge of the North branch, draining about 130 square miles, was said to complicate the control of the city's sewage. It was believed to be wise to divert this stream to the lake in the vicinity of Bowmanville. Flushing gates would control the discharge into the old stream, and a wheel would supply a return current from the lake through the new cut when the normal supply was insufficient. The upper part of the stream as well as the lower would be cleansed by this plan. The Fullerton avenue conduit, rendered unnecessary by this improvement, could be extended further into the lake and used as a tunnel for water supply.

The South branch and the Bridgeport pumping station were discussed, and the belief expressed that an increased quantity of water could be raised from the river and sent down the canal. To improve the condition of the South

fork the committee thought the best plan would be to construct a pumping station and a conduit on Thirty-ninth street to Lake avenue, on Lake avenue to Fifty-sixth street and along Fifty-sixth street to the lake. Besides affording a means of cleansing the South fork the conduit would receive the sewage of the northern portion of Hyde Park. The opening of a navigable channel along Thirty-ninth street was a project worthy of consideration. Such a channel would meet the requirements of permanent bridges in the heart of the city, and of commerce in the southwest district when the National Government might have developed an adequate water communication to the western rivers. The main sewers on Twelfth, Twenty-second and Thirty-fifth streets, which had their outfall into the lake should ultimately discharge into the river. No new outfalls into the lake should be contemplated in the future. The west arm of the South fork, the natural outfall of a large portion of the Town of Lake, would present a serious problem unless it was filled up or extended westward to the canal.

The permanent closing of the Ogden-Wentworth ditch was suggested. "For ten years at least," the committee said, "the ordinary flow of the Desplaines from a watershed of many hundred square miles has come to Chicago to complicate her main drainage and render the canal ineffective, and with each year larger proportions of flood waters find their outlet in this direction, threatening a complete diversion at an early day unless remedial measures are adopted."

Attention was called to the danger from flood discharges. There was liable to be an accumulation of twelve to eighteen inches of water in the form of snow over the Desplaines watershed to be melted quickly by a warm rain. If the rain and melting were accompanied by an ice gorge in the twelve mile level below Summit a great flood would be sent down upon Chicago, resulting in incalculable damage.

Without an ice gorge the results would be seriously disastrous. Both these conditions were possible.

Having stated the conditions affecting the water supply and a proper drainage of the city, the committee recommended the appointment of a body of experts to consider the question in detail. The general problem, as it appeared to the committee, was stated as follows:

1. By keeping the sewage out of the lake, Chicago could avoid a nuisance on her shores and save in changes and extensions of her water supply system a large part if not the whole of the cost of an adequate main drainage.

2. Artificial treatment of sewage is impracticable, because land is not available and the cost would be prohibitory. It would still be necessary to provide means to secure a circulation in the river and its branches.

3. The proper disposal of sewage is unquestionably by way of the Illinois valley, and the sewage must be diluted to the point of complete oxidation.

4. The contents of all channels into which sewage is discharged should be changed, within the city limits, every twenty-four hours.

5. The drainage area tributary to the sewerage district should be reduced as much as possible to limit the effects of a varying rainfall over large outlying districts, and of floods. The main drainage of Chicago involves the entire watersheds of the Desplaines river above Summit and the North branch and the territory south to Sixtieth street, an area of nearly 1,000 square miles. By diverting the North branch to the lake at Bowmanville this area could be reduced more than 120 square miles.

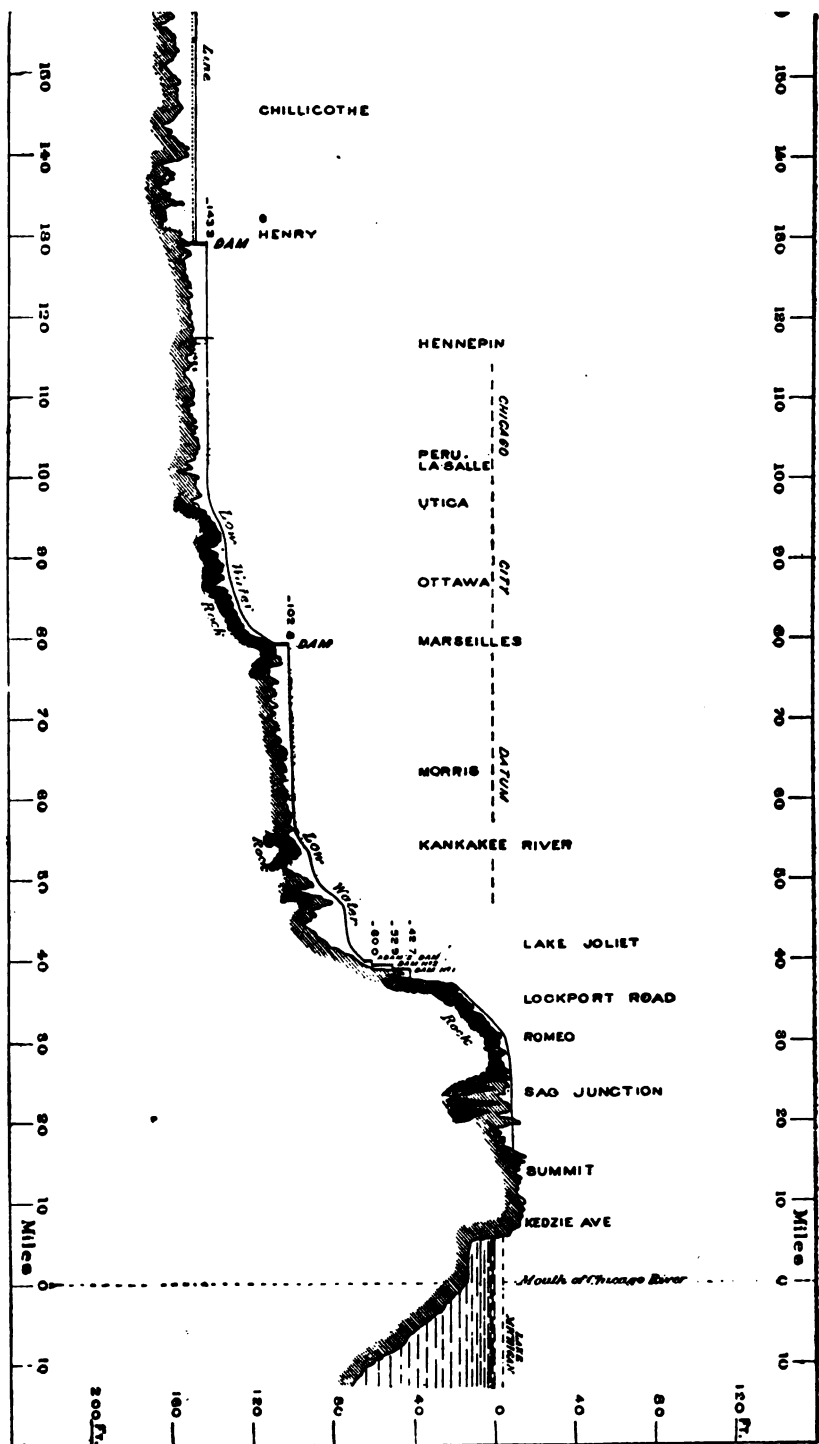
The committee urged the appointment of an expert commission to make the fullest investigation of the question of the proper disposal of Chicago's sewage.

Another committee, whose membership consisted of Daniel L. Shorey, Murry Nelson, H. B. Hurd, Martin A.

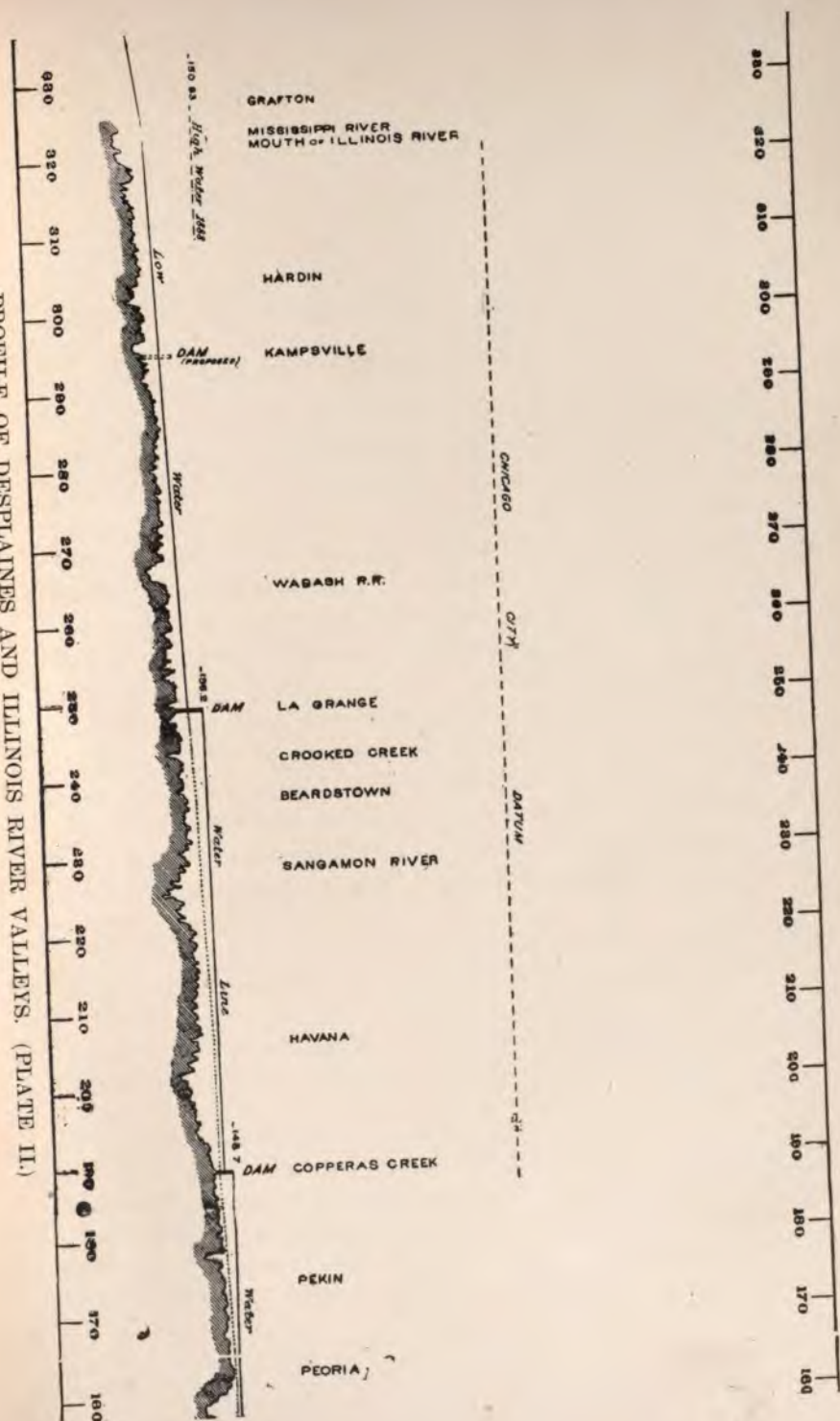
Ryerson and Bryan Lathrop, and in whose recommendations the association concurred, recommended on May 25, 1887, the passage of the Hurd and Roche-Winston bills then pending before the Legislature.

The Citizens' association is entitled to the credit of keeping the drainage question before the people and leading their thoughts in the right direction. This agitation made the correct legislation finally possible.

PROFILE OF DESPLAINES AND ILLINOIS RIVER VALLEYS. (PLATE I.)



PROFILE OF DESPLAINES AND ILLINOIS RIVER VALLEYS. (PLATE II.)



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CHAPTER XXVI.

DRAINAGE AND WATER SUPPLY COMMISSION.

Prompted by the recommendations of the Chicago Citizens' association and the urgent appeals of the press, the City Council passed a resolution on January 27, 1886, authorizing the creation of a Drainage and Water Supply Commission. Mayor Harrison appointed Rudolph Hering as chief of the Commission. Benezette Williams and Samuel G. Artingstall were made assistants. A preliminary report was made by the Commission in January, 1887. In transmitting the report to the City Council Mayor Harrison recommended that a law be enacted to create the new metropolitan district suggested with power to issue bonds or levy assessments and to prosecute the work. The work of the Commission was not carried to a conclusion because the City Council was unwilling to appropriate the funds necessary for its expenses. The preliminary report was as follows :

CHICAGO, January, 1887.

To the Honorable Mayor and City Council of the City of Chicago:

GENTLEMEN: On January 27, 1886, your Honorable Body passed a resolution authorizing the creation of a Drainage and Water Supply Commission. After being amended February 23, it read as follows :

"WHEREAS, Pure water and scientific drainage are necessities of this community, and the people demand a system of water supply and drainage adequate to meet the requirements not only of the present, but of years to come, nor will any temporary expedient or make-shift satisfy them ; and

“WHEREAS, A thorough and permanent system of supplying pure water to our citizens and caring for the drainage of the municipality cannot be paid for out of current taxation, therefore it is desired that a plan shall be devised and perfected before the next meeting of the Legislature to the end that necessary legislation may be had.

“For the purpose of carrying into effect the objects sought, there is recommended the appointment by the Mayor of a Commission to consist of one expert engineer, whose reputation is so high that his opinion and report will command the respect of the community, and with him one or two consulting engineers of like experience in engineering and sanitary matters. The duty of this Drainage and Water supply Commission, made up as above set forth, should be to consider all plans relating to drainage and water supply which may be brought to its attention ; to make such examinations and investigations and surveys as may be deemed necessary ; to collect all information bearing on this problem ; to consider all recent developments in the matter of sewage disposal, and their application to our present and future needs ; to consider and meet the necessity of increasing our water supply and of protecting the same from contamination ; to remedy our present inadequate methods of drainage and sewage disposal ; to consider the relations of any system proposed to adjacent districts, and whether there may not be a union between the city and its suburbs to solve the great problem ; to determine the great question as to the interest which the State and the United States may have in the disposal of sewage by way of the Illinois river ; to devise plans to meet any objections thereto, if such a system shall be thought best ; and, in general, to consider and report upon any and all things which relate to the matter of water supply and drainage of the city of Chicago.

“The Commission should report on the whole matter committed to it in the most full and comprehensive manner, with maps, plans and diagrams complete, and accompany the report with estimates of the first cost and annual requirements for the maintenance of the system proposed.

“The report of the Commission should be made as early as

practicable, and not later than the convening of the next session of the Illinois Legislature in January, 1887.

"In consideration of the foregoing, be it

"*Resolved*, That the Mayor be and is hereby authorized and directed to employ on behalf of the city one expert engineer of reputation and experience in engineering and sanitary matters, at a salary not to exceed \$10,000 per annum, and also to employ such consulting engineers, not exceeding two in number, as may seem necessary, and such assistant engineers as may be required, all to be paid according to services rendered, for the purpose of carrying out the objects set forth in the preamble hereto. For the fees of said assistant engineers and for all expenses connected with said work there shall be allowed not to exceed the sum of \$20,000. All fees, salaries and expenses connected with said work shall not exceed in the aggregate the sum of \$30,000, and the same shall be paid from the water fund of the city upon vouchers audited by the Mayor and city Comptroller."

In accordance with the terms expressed herein his Honor Carter H. Harrison appointed Rudolph Hering as chief engineer, Benezette Williams and S. G. Artingstall as consulting engineers, who, together, should constitute a Commission. Mr. Hering entered upon duty March 28, Mr. Williams September 17, and Mr. Artingstall December 21, 1886.

The investigation designated by the resolution was a formidable one, comprising no less a task than the consideration of the entire subject of the future water supply and drainage of Chicago. It appeared doubtful from the beginning that a report such as was demanded could be furnished within the specified time, for the simple reason, if for no other, that observations of the lake phenomena and of the flow of certain rivers should be extended over at least one year, covering four consecutive seasons, in order to draw satisfactory deductions.

But the large amount of work alone that was asked for made it impracticable to present a complete report in so short a time. It was expected, however, that results could be reached sufficient to indicate the character of legislation required to carry out any project that might be determined upon,

and that therefore a preliminary report having this end in view could be made at the stated time, leaving to a later date the presentation of a report outlining the detailed features of the scheme recommended and embracing the minor results of the entire inquiry.

The present communication is to cover the ground indicated for the preliminary report, and besides containing the conclusions reached regarding the main features of the proposed project, it contains also a brief review of the work done during the past year and of what still remains to be done.

The month of April was devoted to a general examination of the subject, of the territory to be investigated, and of the various suggestions that had been made toward effecting a solution of the problem.

The examination disclosed the fact that the city is sometimes greatly suffering from the offensive condition of parts of the Chicago river and its branches, caused by the discharge of sewage into the same, and from the occasional contamination of its water supply, brought about by the discharge of the polluted contents of the river into the lake. It also disclosed the fact that almost every conceivable way of dealing with these questions had been suggested and in some forms applied during the past thirty years.

The problem therefore demands the attainment of two ends: the protection of the water supply and the removal of the river nuisance. As the water must be taken from the lake, it is evident that both its pollution and the objectionable condition of the rivers should be prevented by a better disposition of the sewage. It is therefore the latter question which constitutes the main object of this investigation.

Among the possible methods of getting rid of the Chicago sewage there are but three that have been deemed worthy of an extended consideration, namely, a discharge into Lake Michigan, a disposal upon land, and a discharge into the Desplaines river. The preliminary work has therefore been confined to these three projects, and was classed as topographic, hydrographic, and miscellaneous.

At the time when the present Commission began its labors

the topographical work had already received some attention. Surveys were being made of the Desplaines river from Bridgeport westward under the direction of Mr. Artingstall, city engineer. These surveys were continued, and have now been completed as far as Joliet. They include contours of the entire valley and borings to rock between Bridgeport and Lemont. In order to understand the hydrography of the Desplaines valley above the point where the Chicago sewage could be discharged into it, and also to ascertain the probable magnitude and effect of floods in the river, a survey was made of its bed as far north as Northfield township. To determine the area of the basin its entire divide was located. To ascertain the practicability of diverting the flood waters from the upper portion of the Desplaines, and North branch watersheds directly into the lake, and thus avoiding the difficulties which would arise from their passing through the Chicago river, all feasible lines were surveyed. Finally, a few levels were taken of the area adjoining the city wherever no connected levels existed to show the general topographical features of the territory over which the future city will spread out and from which the drainage will require artificial removal.

The hydrographic work consisted in ascertaining the flow of the Desplaines river, the rainfall upon its area, its flood discharges, the character of its bed, and the probable effect of discharging the Chicago sewage into it when diluted by a large and constant stream of water from the lake. It consisted, further, in examining the nature of the currents in the lake and in studying the rise and fall of its level, and in ascertaining the amount and character both of the sewage discharged into it and of the deposits in the river and lake in front of the city, to determine the effects of the present sewage disposal.

Inquiry and surveys were made to show the feasibility of purifying the Chicago sewage by filtration on land. Land damages were carefully estimated for the different schemes; existing records were searched concerning borings and excavations made in and about the city, so that the practicability of certain lines of tunnels could be discovered; the probable growth of the city and its suburbs, as well as the probable dis-

tribution of the future population, received a careful attention ; and, finally, a large number of data were compiled which pertain to the existing works of water supply and sewerage in Chicago and the adjoining towns.

In reporting the results thus far gained, we will present them in the order most convenient for discussion, but before doing so will briefly describe the present manner and effect of the sewage disposal, as shown by this investigation.

PRESENT SEWAGE DISPOSAL.

The sewerage works of Chicago and suburbs have been planned on what is called the combined system, in which the sewers serve for the removal both of sewage and rain water. In the town of Evanston they empty into the lake. In the town of Lake View they partly discharge into the lake and partly into the North branch. From the North and West divisions and part of the South division of Chicago the drainage enters the Chicago river and its branches, and from the remaining part of the South division it flows into the lake at three outlets, situated respectively at Twelfth, Twenty-second and Thirty-fifth streets. The sewers of Hyde Park discharge into the lake, excepting those of Pullman, where the sewage is disposed of on land. The town of Lake, including the Stock Yards district, drains into the South fork of the Chicago river.

When the sewerage works of the city were designed, in 1856, by Mr. E. S. Chesbrough, it was apprehended that ultimately some means would have to be found to change the water in the river from time to time or to keep the sewage entirely out of it. The first step toward improving the condition of the river was taken by deepening the Illinois and Michigan canal, so as to cause a current from the lake to the Desplaines river at Lockport. The next step was the building of the Fullerton avenue conduit in order to produce a circulation in the North branch ; and the last step was the erection of the canal pumping works to increase the flow in the river, which had become greatly polluted.

The influence of these works is confined to the main river and its North and South branches. But the South fork of the

latter, receiving a large amount of sewage from Chicago and the town of Lake, and charged with the waste from the Union Stock Yards and packing houses, has no artificial means for a circulation of its water, and as a consequence is in a condition of great filthiness.

The accompanying diagram* has been prepared to show the present pollution of the Chicago river and its branches during the time when all of their water is discharged into the canal by the Bridgeport pumps. On the left are shown the main river and the North branch, one above the other, their combined waters forming the South branch, and reaching Bridgeport on the right, where they are lifted into the canal. At the latter point the South fork is shown as joining it. The shaded portions indicate the amount of sewage entering and passing the respective points, and the blank portions the lake water diluting it. The degree of dilution is shown by the relative areas. It diminishes in the North branch from Fullerton avenue to the South branch, and becomes still less toward Bridgeport, and finally receives the foul waters of the South fork.

The depth and character of sewage deposits in the river and harbor, as might be expected, vary considerably. They are not great in the track of the vessels, but increase toward the docks and quieter portions of the slips, where they reach a depth of from one to four feet. While the deposits in the channel are of a heavier kind, such as cinders, those in the docks are mostly a foul mass of decomposing organic matter. No form of life is found to exist above Clark street bridge as far north as Clybourn Place, and as far south as Ashland avenue. The effect of this condition of the river is to endanger the purity of the water supply whenever the river, with its accumulated deposits, flows into the lake, which occurs when the rain water that finds its way into the river exceeds the amount pumped into the canal. If this excess is great, as in the spring, and occasionally in the summer months, the contamination of the lake is considerable, and must constantly increase.

* Omitted.

From the foregoing it is seen that the present method of disposal of the sewage from Chicago and its suburbs is partly by discharging it into Lake Michigan, but mainly, except during floods, by discharging it into the Desplaines river.

FUTURE POPULATION.

The first question which required an answer, and upon which many of the subsequent inquiries depended, was the population which it is economical and advisable to consider at present, and the extent of territory upon which such a population will be located.

The growth of Chicago has been frequently quoted as phenomenal. Estimates made thereof for various purposes have turned out to be rather under than over the actual result.

It is taken for granted that Chicago and its suburban towns will have to dispose of their sewage so that the water supply for the entire community residing near the lake from the south line of Hyde Park to the north line of Evanston will be guarded against pollution by the sewage from any one of the separate communities. For this purpose the whole populated area within the above limits is considered as forming one city with a common interest.

The growth of this metropolis was obtained partly from the United States census and partly from the school census of Cook County, which give a record up to the summer of 1886. In order to forecast the probable ratio of the future increase, it was desirable to compare this growth with that of other cities. By considering the ratio of increase elsewhere, and including the natural suburbs of each city, a fair and instructive basis of comparison was obtained; and by realizing the respective natural advantages for growth in each of the communities, the probable ratio for Chicago was determined with a satisfactory degree of exactness.

The accompanying diagram * shows the results of this comparison. It represents by curves the population of the largest cities in the country since 1790, not as usually quoted from the census, giving the inhabitants on certain arbitrary areas

* Omitted.

fixed by law, but as virtually making up the population of the respective municipalities, by including adjacent towns and natural suburbs, the only method which enables the true growth of the great cities to be recognized. For instance, the New York center naturally includes Brooklyn, Jersey City, Hoboken, Newark, and other suburbs, and Chicago the entire territory from Hyde Park to Evanston.

The diagram indicates that the character of growth of the different cities permits them to be divided into two distinct classes. Philadelphia, Boston, St. Louis and Cincinnati show very much the same character of increase, and represent by comparison the more conservative communities. New York and Chicago, on the other hand, while showing a remarkable resemblance to each other, form quite a contrast to the rest of the cities, and might be called the more progressive communities. The diagram finally indicates the time when the Chicago curve, which was the lowest one prior to 1864, intersected in turn those of St. Louis, Cincinnati, Boston, and there is a high degree of probability of its intersecting the Philadelphia curve in or before 1891, *i. e.*, in four years from now, after which Chicago will be the second largest center of population in America.

As it is not practicable in so young a city as Chicago to forecast a definite line of growth, it is preferred to give the probable maximum and the probable minimum between which the true line will most likely be contained. The minimum line represents a growth resembling that of New York, and the maximum line assumes the ratio of increase per decade to be constant instead of gradually decreasing, as in most other cities. The result indicates that the population of Chicago and suburbs will be two and a half millions between the years 1905 and 1915, or about three times the present population in eighteen to twenty-eight years.

In providing public works for large communities it must be borne in mind that it is economical to invest only such sums as will bring a return within a certain number of years, leaving expenditures for benefits that will be realized only at a later time to a later generation. This fact, together with

the probable growth of Chicago, shows it to be economical and judicious at present to plan works sufficiently extensive to dispose of the sewage of not less than 2,500,000 inhabitants.

In addition to the population, the area that will be occupied by it has to be determined. While this is a far more difficult task, owing to the many accidental causes influencing the distribution of the population, it is possible, nevertheless, to outline the area sufficiently close for present purposes.

The future metropolis, with a population three times as great, will be distributed along the lake from South Chicago to Evanston, and will reach inland to the Blue Island ridge in the south to the Desplaines river in the center, and to the higher parts of Niles township in the north. Outside of these general limits, a more or less dense population will extend for some distance along the lines of railroads.

As inferred above, it is proper to consider at this time the wants of the population that will reside upon this entire territory.

DISCHARGE OF THE SEWAGE INTO LAKE MICHIGAN.

To discharge the sewage from cities into comparatively large bodies of water is not only usual, but often the best method for its disposal. Dilution and dispersion thoroughly expose it to the action of the oxygen contained in both the water and the superincumbent air, and it is thereby gradually oxidized. Where the body of water is a large river with a strong current, the best conditions for such purification are found. Where it is a lake in which the circulation is slight and irregular, the efficacy of the method is less, and depends for its success on the character of the currents and the relative amount of sewage to be discharged into it.

The hydrographic surveys of the lake made during the past season were therefore partly for the purpose of ascertaining, if possible, the laws governing the currents, so that we would know their effect in dispersing the sewage discharged into the lake. The trend of the shore currents was actually ascertained by daily recording the direction of spar-buoys placed at the Chicago waterworks crib, at Michigan City, and at St.

Joseph. A large number of bottle floats were thrown into the lake at different points and different times for the same purpose. They were partly single surface floats and partly double, the lower one being placed at varying depths according to the depth of the water. More than half of them have been picked up and returned, with place and date noted. The currents were also observed by means of large can-buoys from an anchored tug-boat at different points in the lake, extending from Hyde Park to Evanston, about six miles from the shore. And two general lake trips were undertaken, one to St. Joseph and back to Grosse Point, and another one parallel with the shore around the head of the lake.

When the observations are completed and compiled in detail some valuable information will be available for the question of water supply. Light will be thrown on the movement of the water under different winds, and the sudden changes of temperature of the water at the crib and on the turbidness of the same.

The following results have a bearing on the question of sewage disposal. Where not affected by local conditions the currents practically go with the winds in water of moderate depth and quickly respond to any change. In deep water also the surface currents run with the wind, but at the bottom and even at mid-depth the direction is usually different. The prevailing current along the shore of Cook County during the past summer has been observed to be toward the north, but it is possible that this result may be different during the winter months. In the open lake wave action seems to be effective in preventing the permanent deposits down to a depth of about sixty feet; inside of the breakwater sewage deposits are found on the bottom.

The general deduction from these results is clear that, as no constant current exists which would carry the sewage away in one direction, it should be discharged into the lake at one end of the future city, while the water supply should be obtained as far away from it as practicable toward the other end; a conclusion which is being acted upon in the other large lake cities. The proper place from which to bring the water would be opposite

Grosse Point, and the sewage discharge should be east of Hyde Park. While it might be practicable to allow the sewage in its crude form to enter the lake under such conditions for many years, the necessity would arise later for clarifying it at least partially previous to its discharge. It could not be allowed to run into the rivers as at present, but the dry weather flow and a considerable amount of storm water would have to be intercepted and carried to the outfall through many miles of special conduits. And this entire quantity would have to be raised by pumping in order to get sufficient head to empty into the lake, while the diluted sewage during storms, in excess of the capacity of the intercepting sewers, would be allowed to discharge directly into the river.

The water supply would have to be brought from Grosse Point in large conduits to the several pumping stations scattered over the city and its present suburbs. The circulation of the water in the Chicago river and branches would have to be maintained practically as it is at present, because the removal merely of the dry weather flow of sewage would not altogether prevent its pollution.

DISPOSAL ON LAND.

We shall not at this time enter into a general discussion of the principles underlying land purification of sewage, or make historical references showing the success or ill-success of the method as practiced elsewhere. We will simply state that with good management under ordinarily favorable conditions a disposal on land proves satisfactory, so far as the purification of the sewage is concerned, and that with proper conditions in the way of good markets and a favorable soil and climate, sewage farms can be operated on a large scale after the sewage is delivered upon the same without financial loss.

In speaking of a sewage farm of the magnitude required for the metropolitan area of Chicago, it is not understood as being land devoted primarily to the raising of crops, using the sewage only when and where it would most promote the growth of vegetation. The primary object would be the purification of the sewage on an area of land as small as could serve the purpose. Technically speaking, the sewage disposal would be

by means of intermittent filtration rather than irrigation. To carry out such a scheme for Chicago involves the following:

(1) The acquirement of sufficient land suitable for the purpose.

(2) A comprehensive system of intercepting and collecting sewers carrying the sewage to the farm.

(3) Pumping-works of a capacity to handle all the dry-weather flow of sewage and a certain proportion of storm water.

(4) A thorough underdrainage, leveling, and preparing of beds for the filtration areas.

(5) A system of underground conduits and surface carriers for distributing the sewage over the ground, and a system of open ditches for removing the purified water to the nearest water courses.

(6) Buildings, roads and a complete farming outfit.

(7) An organization for properly distributing the sewage, for carrying on the farming operations, and for conducting the business of disposing of the crops in the best market.

In making estimates for the size of intercepting sewers, conduits, pumps and area of land required, we have used as a basis a population of 2,500,000 people, with an average dry weather sewage discharge of 150 gallons, or 20 cubic feet per head daily, and made provision for storm water equivalent to one-fifth of an inch in twenty-four hours over all portions of the district now drained, or likely to be drained, by a combined system of sewers, allowing surplus water to escape into the rivers and lakes.

The dry weather flow of sewage would therefore be 50,000,000 cubic feet per day, and the maximum flow of storm water 65,000,000 cubic feet per day, making a total maximum discharge of 115,000,000 cubic feet.

From an examination of rain fall tables we conclude that the annual amount of storm water that would be carried off by such an intercepting system would range from nine to twelve inches, an average of which in round numbers may be taken at 40,000 cubic feet per acre per annum over the area drained by a combined system of sewers. It is practicable, however, to

exclude the storm water from the sewers over a large portion of the future city by adopting the separate system of sewerage. The area north of the town of Jefferson and of the middle of Lake View may be treated to advantage in this way, and also a large portion of Hyde Park, Lake, Calumet and other adjoining towns.

Assuming that the area which does not allow the storm water to be entirely excluded is 140 square miles, the average daily amount becomes 10,000,000 cubic feet, which gives, when added to the sewage, 60,000,000 cubic feet, or 24 cubic feet per head of population per day to be provided for on the farm.

As the amount of land required to purify sewage can only be determined by experience, and as this has been very limited in our own country, we are forced to rely mainly upon that of Europe. Without going into details at present, we will simply state that a fair consensus of this experience justifies us in the conclusion that from 10,000 to 15,000 acres of land would be required to dispose of the sewage from the entire metropolitan area.

The only available territory for sewage filtration in the neighborhood of Chicago consists of two sandy ridges in the town of Thornton, extending across the State line into Indiana, and in a sandy ridge crossing the town of Niles. The soil is quite favorable, but the character of the surface is such that the necessary preparation to make it suitable for filtration beds would be comparatively expensive. An enormous cost is, however, represented by the fact that the sewage would have to be collected by large intercepting sewers, lifted altogether some 90 feet and carried about 20 miles before reaching the farms. We therefore consider such a project entirely impracticable.

The land treatment can only be seriously thought of in connection with the sewage disposal from the smaller areas mentioned above and comprising the extreme northern and southern parts of the future metropolis. The drainage of parts of Evanston, Lake View and Niles might be taken to the sandy ground in the latter town, and that of the Calumet region to the sandy ridges in Thornton, should this method be found most advantageous when compared with others.

The preliminary investigation made for this purpose consisted in an examination of the grounds, in the projection of a farm, and in an estimate of the cost of preparing the same and delivering the sewage to it by intercepting sewers and conduits.

DISCHARGE OF THE SEWAGE INTO THE DESPLAINES RIVER.

A third solution of the drainage problem is rendered practicable by the fact that the divide between Lake Michigan and the Mississippi Valley lies about ten miles west of Chicago, with so slight an elevation that it is not a difficult matter to carry the sewage from the city westward into the Desplaines river and thence into the Mississippi river. This method of disposal, as previously explained, is in fact mainly the present one, most of the sewage now being carried across the divide by the Illinois and Michigan Canal.

There are two low depressions between the future metropolis and the Desplaines river—the Mud Lake valley, with the present canal, and the Sag valley, west of Lake Calumet. Neither is more than ten feet above the lake, nor do they present any engineering difficulties for canal construction. It is therefore quite feasible to carry all the drainage from the territory ultimately to be occupied by the metropolis, extending from Lake Calumet to Evanston, into the Mississippi Valley through these depressions, avoiding thereby all possible lake pollution, and permitting the supply of water to be drawn from any number of convenient points in front of the city.

A possibility of this solution was recognized as early as 1856 by E. S. Chesbrough, and the first step toward its adoption was taken, as already mentioned, by turning the sewage into the Illinois and Michigan canal. Not until quite recently, however, has it become practicable to consider the construction of a special waterway for sewage removal, because when the population was smaller the expense of the undertaking was too great.

The sanitary requirements demand a flow of water large enough to dilute the sewage sufficiently to make it inoffensive along the river at all times. Beyond this, any increase in the size of the channel to provide for the storm water which natur-

ally enters it, should be kept at a minimum. A glance at the map and an examination of the ground show the possibility of diverting the greater part of the storm water from the metropolitan district without serious difficulty. Both branches of the Calumet river can be diverted west of the Indiana State line into Wolf lake, and thence into Lake Michigan. The Desplaines river can have its flood waters diverted into the North branch near the north line of the town of Jefferson, and the combined waters can be led from Bowmanville directly into the lake. Salt creek, a branch of the Desplaines river, can readily be turned southwardly near Western Springs, through a water course known as Flag creek, at one time evidently its old bed, discharging into the Desplaines, opposite Sag, and thus reducing the necessary storm water capacity in the new channel between Sag and Summit.

In order to determine the probable quantity of flood water which can thus be excluded, it was necessary to ascertain the maximum flood discharges from all the water sheds in question. This requirement called for a gauging of Desplaines, North branch and Calumet rivers, a gauging of the rainfall, which is a measure of the stream flow, a survey of the water sheds, and an examination of the river channels. It was also necessary to make a reconnaissance of all possible lines for diverting the Desplaines, the North branch, the Calumet rivers and Salt creek, and a survey of those which were most important.

The results indicate that each one of these diversions is both practical and economical. By adopting the "separate system" of sewerage for the territory lying north of the proposed Bowmanville channel, the surface drainage from this territory can be safely turned into the lake.

A second branch of the investigation extends to the elements governing the proper size for the waterway from which a large proportion of the storm water has been excluded. The area still draining into it will consist largely of paved streets and roofs, allowing of no absorption and shedding the water rapidly. It requires a careful consideration to determine the maximum quantity of water that may enter the proposed chan-

nel, and for which an ample allowance must be made to prevent a back flow of the polluted water to the lake.

The proper degree of sewage dilution in the new channel demanded a careful investigation. When sewage is mingled with a sufficiently large quantity of water it not only becomes inoffensive, but readily finds the oxygen which gradually purifies it. When the surface is covered with ice a greater dilution is necessary for this purpose than at other times when there is a constant replenishment of oxygen from the air. The proposed waterway should of course provide immunity from offense at all times.

The information upon which definitely to decide this question will be given in the final report, as the data have not yet been all collected, owing to the necessity of making actual tests of the oxidization of the canal water under the ice, which is being done for the use of the Commission by Dr. J. H. Rauch, Secretary of the State Board of Health. The summer conditions are presented in his late report on the water supply and sewage disposal of Chicago. The result of these analyses will be compared with those of other streams that are also polluted with sewage in order to show the rate of oxidization with varying degrees of dilution and aëration.

For the purpose of estimating the cost of the water channel we have assumed 3,600 square feet for the cross section and a velocity of the water three feet per second or two miles per hour. This gives a discharge of 600,000 cubic feet of water per minute, or 24,000 cubic feet for each 100,000 persons, which we believe equal to the maximum requirements of a population of 2,500,000 people.

A third branch of the inquiry covers the selection of routes for the proposed canals.

Between Chicago and Summit three lines are practicable: One following the West fork and Ogden ditch, and another extending from the southwestern end of the South fork in a westerly direction to the Ogden ditch, and thence to Summit, and a third being an enlargement of the present canal. We are of the opinion that eventually both the first and second of these lines should be adopted, but the second one should be built first

in order to secure circulation in the South fork. From Summit westward the bed of the river and the present canal were the only lines to be considered. The best location has not yet been finally determined.

For the drainage of the Calumet region a simple inspection shows that a canal should start from the river at the southern point of Blue Island and extend almost directly westward to the Desplaines valley at Sag.

A fourth branch of the inquiry relates to the study of such data as have reference to securing a proper circulation for the waterways within the city.

To throw light upon this point the variations of the lake level have been recorded since last spring by means of an automatic gauge, indicating an almost continual fluctuation, averaging several inches and recurring at periods of about twenty minutes. During a low pressure of the atmosphere the amplitude of these oscillations increases, and not unfrequently reaches several feet. The accompanying diagram* shows the level of the lake on August 16, 1886, at a time when an area of low barometer passed over it. From 6:40 A. M. to 6:55 A. M., that is, in fifteen minutes, the water fell 2 feet 10 inches.

A rising level causes an inflow to the river and drives the water of the latter into the slips, where it deposits a portion of its suspended sewage matter and becomes foul. A falling level reverses the flow, and the slips empty their foul water into the river and lake. During heavy fluctuations of the latter, such as the one referred to above, it has been traced more than a mile in the direction of the crib.

As the proposed canal from Bowmanville to the lake will lower the water of the North branch at this point to the lake level, provision must be made for its circulation. The size of the Fullerton avenue conduit is not sufficient to furnish the water required for a current in both directions, nor would such an arrangement be satisfactory or economical. It will be necessary to establish a flow toward the South branch from the lake opposite Bowmanville in order to prevent a future lake pollution by the proposed channel. This can be accomplished

*Omitted.

by placing a lock in the North branch at any point that may be found most desirable, and raising the water at the same time about one foot. If such a lock is placed at Fullerton avenue the present pumping works, with slight modifications, can be utilized.

Finally, it must be mentioned that circulation can be secured in the proposed waterway of the Calumet region, into which the sewage is discharged, by a gravity flow from Lake Michigan into the Desplaines valley through Lake Calumet and the Sag. The detailed features of this project have not yet been wholly matured, the estimates of cost being based on a channel having a capacity of 1,000 cubic feet per second.

COMPARISON OF PROJECTS.

In the foregoing we have outlined the main features of the only three feasible methods of disposing of the metropolitan sewage, and have given the results of the investigation reached to date. A general conclusion as to the preferable method may be given at present, and also an approximate estimate of cost. But we are not able as yet to give either conclusions or detailed statements of the probable expense regarding all parts of the proposed work, and must defer them until the final report.

In comparing the projects we will first mention their probable cost and then their relative advantages.

The discharge of the sewage into the lake from a population of 2,500,000 in the manner described above, including the extra expense, otherwise not necessary, of taking the water supply at Grosse Point, would cost at least \$37,000,000, with an annual expense for interest and operation of at least \$2,400,000. It would require an immediate investment of about \$20,000,000.

To dispose of the entire metropolitan sewage by filtration on land would require an investment of about \$58,000,000, with an annual expense of over \$3,000,000 for interest, pumping and maintenance, after deducting the profit from the sale of crops. It would be necessary to invest at once about \$34,000,000. Land disposal for the sewage from the Calumet region alone, with a future population of 300,000, would require an

investment of \$4,000,000, and an annual expense of at least \$250,000.

Finally, the cost of the Desplaines project is approximately estimated as follows :

(1) A channel from the South fork to Joliet, of the capacity heretofore given, will cost between \$17,000,000 and \$21,000,000.

(2) A diversion of the flood waters of the Desplaines, the North branch and Salt creek will cost between \$2,500,000 and \$2,800,000.

(3) Pumping works and locks for the North branch will cost about \$150,000.

(4) A separate system of sewers to collect the sewage now discharged directly into the lake and to carry it into the river will cost about \$600,000.

(5) A channel from Lake Calumet to Sag will cost between \$2,500,000 and \$3,000,000.

(6) A diversion of the flood waters of the Calumet river will cost between \$350,000 and \$400,000.

The total cost of the Desplaines drainage project would therefore be for the main district between \$20,250,000 and \$24,550,000 ; for the Calumet district, between \$2,850,000 and \$3,400,000. The annual cost, including interest, etc., is estimated at about \$1,300,000 per annum.

The pollution of the lake can be decreased, and the present condition of the Chicago river, and particularly of the South fork, can be improved by the immediate construction of the following works, which, with the exception of the pumping works at the South fork discharging into the Illinois and Michigan canal, are all a part of the final plan :

(1) Channels diverting the flood waters of the Desplaines, North branch, and Salt creek, as described above.

(2) A modification of the Fullerton avenue pumping station, and the construction of locks for the purpose of getting circulation in the North branch.

(3) A separate system of sewers to collect the sewage now flowing into the lake from the South division and to discharge it into the South fork.

(4) A waterway extending from the South fork to the Illinois and Michigan canal, with a new pumping station to promote circulation.

(5) By raising the banks of the canal and by removing deposits its capacity can be increased 40 per cent at a small cost, and thus provide for a greater flow of water in the same.

The cost of the works comprised under these five items is estimated to be between \$5,000,000 and \$5,500,000. They could be finished in three years, and would greatly lessen the liability of polluting the water supply, while the sewage would be disposed of in the best practicable manner until the final completion of the Desplaines project.

It therefore appears that this project is decidedly the least expensive one for the present as well as for the future.

Besides the economical advantages of the Desplaines scheme, its superiority is still further emphasized by advantages of another kind. The proposed canal will, from its necessary dimensions and its regular discharge, produce a magnificent waterway between Chicago and the Mississippi river, suitable for the navigation of boats having as much as 2,000 tons burden. It will establish an available water power between Lockport and Marseilles fully twice as large as that of the Mississippi river at Minneapolis, which will be of great commercial value to the State. The Calumet region will be much enhanced in value by having a direct navigable channel to the Desplaines river, and by a lowering of the flood heights of Calumet lake and river. Within the city the water of the Chicago river and its South branch will get a much better circulation if it flows by gravity than if it has to be pumped, the necessity for which would remain even if the sewage should be discharged through intercepting sewers either into the lake or upon land. Under either of the latter conditions an occasional overflow from the sewers into the river during heavy rains would be more objectionable than a constant discharge of sewage into a more rapidly flowing stream. Flood waters entering the lake by way of the Chicago river would carry into it much filthy matter, either suspended or deposited, notwithstanding the existence of intercepting sewers; but the proposed diversion

of such waters before reaching the populated districts will for all time obviate this undesirable occurrence. Lowering the level of the North branch at Bowmanville by its diversion to the lake will be equivalent to raising the low prairie extending toward Evanston and Niles, and greatly benefit parts of these towns.

THE WATER SUPPLY.

In reaching the conclusion that the sewage of the city should be discharged into the Mississippi valley, the question of water supply is materially simplified, because the lake will then at all times furnish good water wherever intakes are desired for an extension of the works.

The preliminary inquiry, made with a view to ascertain the main features of an increased supply, comprised first a compilation of data concerning the existing works both in Chicago and its suburban towns, which were collected mainly through the courtesy of the respective authorities; and, secondly, a study into the most economical method of distributing the water over the metropolitan area. The following is a brief description of the existing works:

The present intake for the public water supply of Chicago is located in Lake Michigan, about two miles from shore, and the water is conducted to the city in two circular brick tunnels 5 and 7 feet in diameter. They extend parallel to each other under the bed of the lake, and 50 feet apart, to the north pumping works, where they are connected, and where the 5-foot tunnel terminates. The 7-foot tunnel is continued under the city for a distance of 20,500 feet, to supply the west works, on Ashland avenue, near Twenty-second street.

The tunnels from the source to the shore are built at a depth of 80 feet below city datum, or low water in the lake, and the 7-foot tunnel is continued on the same level for a distance of about 11,500 feet, where, to avoid rock excavation, it is inclined upward until, at the west pumping station, the top is but 21 feet below city datum. The economical capacity of the two tunnels is between 90,000,000 and 100,000,000 gallons per day, or less than the present average daily consumption of water. Their maximum capacity is reached when delivering

about 150,000,000 gallons per day; which is now nearly equaled by the demand during the hours of greatest consumption, and, at the present rate of increase, it is estimated that during the summer of 1887 the maximum demand for water will be at the rate of 145,000,000 gallons per day; during 1888, 155,000,000 gallons per day; during 1889, 167,000,000 gallons per day, and in 1890, 180,000,000 gallons per day.

To provide against accident or obstruction from ice or other cause in the main tunnels, and to provide against an inadequate supply in the near future, which appeared inevitable, a new tunnel is in process of construction. The intake is located 1,500 feet from the shore, and connection is made with the other tunnels of the north pumping works.

The distribution of the water is effected by pumping it directly into the water mains at the north and west stations. At the north works the three tunnels are so arranged and constructed that any one of them can be emptied when desired for repairs or cleaning, and both the pumping stations still be supplied with water from the other tunnels. The total pumping capacity of this station is at present 67,000,000 gallons per day, but it will be increased to 91,000,000 gallons per day as soon as the new pumps now in process of erection are in operation.

The connections between the pumps, stand-pipes, and distribution mains at these works have become so complex by the successive additions to the plant that an unnecessary loss of head is the consequence. As this can be remedied to some extent without great expense, we recommend that it be done at the first favorable opportunity. The station, being on the shore of the lake, is not centrally located with reference to any part of the city, which renders it necessary to use a greater length of main pipe, with a consequent loss of pressure to reach the consumers, than would otherwise be the case. The total pumping capacity of the West side station is 60,000,000 gallons per day, and the connections between the pumps, stand-pipes and mains are simple and effective, and the loss of pressure from this cause is a minimum. The location is better adapted to secure economical and satisfactory results

than that of the north works, and with reference to additional pumping stations which will later be necessary in other parts of the city, these works are well situated.

The following table, compiled from the annual reports for 1884 and 1885, gives a detailed comparison of the cost of pumping at two stations, anthracite coal being used at the North side and good bituminous coal at the West side.

Cost of pumping 1,000,000 gallons one foot high.

Nature of Expenditures.	1884		1885	
	North Side.	West Side.	North Side	West Side.
Salaries.....	\$0.01488	\$0.02022	\$0.01560	\$0.01667
Fuel.....	.05313	.02855	.04590	.02482
Lubricants.....	.00064	.00186	.00057	.00160
Miscellaneous.....	.00323	.00417	.00133	.00401
Total.....	.07188	.05480	.06340	.04710

The hydraulic merits of the system are shown on the diagram* of water pressures from a survey made in December, 1886. The pressures have all been reduced to a common height above city datum and to a uniform height of water at the works. That diagram shows a greater loss of head in the vicinity of the North side station than at the West side. This is accounted for by the complex arrangements heretofore mentioned, and also by the relatively small area of mains, being only 16½ square feet at the North side and over 21 square feet at the West side. Nearly equal quantities of water are pumped at each of the stations during the middle of the day.

The following table shows the pumping capacity of all the suburban towns having a public water supply, and the pressure ordinarily maintained at the works. With the exception of South Evanston, all take water from Lake Michigan:

* Omitted.

Locality.	Individual pump capacity.		Total pumping capacity per day.	Ordinary head at pump, in feet.
	Pumps.	Capacity per day.		
		<i>Gallons</i>		
Hyde Park.....	2	3,000,000		
Do	1	12,000,000	18,000,000	103 to 150
Lake	2	4,000,000		
Do	2	2,000,000	12,000,000	100 to 190
Lake View	1	5,000,000		
Do	1	3,000,000	10,000,000	92
Do	1	2,000,000		92
Village of Evanston.....	1	3,000,000	3,000,000	92
Total	11		43,000,000	

At the artesian well supplying the village of South Evanston there is a head of about 53 feet.

The pressure at different parts of the pipe system is very irregular. In Hyde Park it varies from 165 feet at the pumps to 10 or 12 feet at Forty-third street. In the town of Lake the average head at the town hall is reported about 10 feet with 188 feet at the pumps. In Evanston, South Evanston, and Lake View the difference of head in various parts of the villages is not very great.

The following table gives a comparison of the consumption and cost of water in Chicago and the suburban towns :

Locality.	Year	Average head at pumps.	Average daily pumpage.	Cost per million gallons, delivered.	Cost of pumping 1,000,000 gallons 1 foot high.
Chicago (North Side).....	1885	113	38,369,134	\$7.17	\$8.06034
Chicago (West Side).....	1885	105	53,280,880	4.95	.04071
Evanston (village).....	1886	113	787,000	17.00	.15000
Lake View	1886		1,983,000	11.85	
Lake	1886	163	7,292,023	8.80	.05400
Hyde Park	1886		3,410,000	8.92	

The second point of inquiry was a study into the most economical method of distributing the water over the metropolitan area. We will at present refer to it but very briefly, mentioning only such conclusions as pertain to the immediate demands,

and leaving a fuller discussion of the details of this important question to the final report.

The comparatively level area upon which the city is located, and the practicability of taking the water from the lake along the city front at any desired point, after the sewage has been diverted, permits the most economical distribution to be ascertained by mathematical investigation to a much greater degree of exactness than is usually possible.

It is found to be less expensive for the densely populated areas to have pumping stations about two or three miles apart, because the loss of head and cost of mains and pumping to obtain the least allowable pressure are thus reduced to a minimum. In planning new works this fact should be considered, and locations so selected that they will be advantageous for the future as well as for the present.

The localities which we believe to be most suitable for additional pumping stations are : Near Twelfth street in the central part of the city, near the Union Stock-Yards, near Humboldt Park, and near Fullerton and Racine avenues.

When it is considered that at the present time the pumps are delivering during the busy part of the day at the rate of 120,000,000 gallons in twenty-four hours, which is nearly the maximum capacity of all the machinery, and that even with this large consumption of water it is impossible in some parts of the city to obtain water in the second story of the buildings, it becomes evident that an increased supply is imperatively required, and being a work of years to build new tunnels, inlets, buildings, and machinery, the necessity of deciding upon the location of the new works as soon as possible is readily seen. The locality which is suffering most from the want of water is the business section and the south part of the city, the lowest pressure extending from Twelfth street to the city limits. It will become necessary in the future to have two stations in this territory, one between Harrison and Twelfth streets and the other to be somewhere east of the Union Stock Yards. We are strongly of the opinion that of the two stations it will be advisable and most advantageous to build the one north of Twelfth street first, for the following reasons:

(1) It will require a shorter tunnel from the lake to the proposed station and less expenditure for main discharge pipes to connect with the present system than would be the case with the proposed southern station. This is equivalent to less cost and a saving of time in construction.

(2) If the southern station is built first it will require mains of larger capacity leading toward the city than will be ultimately necessary when the central station is built.

(3) The location recommended is near the center of the greatest consumption of water, and will be a gain not only in obtaining greater pressure in the business district, but in removing the cause for complaint on the South side by increasing the pressure so that the water will flow to the upper floors of the highest buildings.

(4) All other parts of the city will gain by the construction in this location, as the North and West works will be relieved of the enormous drain upon them to supply water for the business part of the city. They will be better able to give a good head on the North and West sides, where the population is increasing very rapidly, and which will very soon be in the same unsatisfactory condition as now obtains in the southern end of the city, unless relief is afforded in the manner indicated.

The other pumping stations will gradually become necessary as the population increases, and for a population of 2,500,000 there will be a need for a total combined capacity of 375,000,000 gallons to provide for a daily consumption of 150 gallons per head. With several intakes and tunnels the danger from stoppage of the water supply by ice or accident will be reduced to a minimum, as it is not probable that more than one of them will be so endangered at the same time.

We believe that a submerged intake will afford a more reliable and safer structure, so far as injury from passing vessels and stoppage by ice are concerned, than a structure projecting above the water.

With the sewage kept out of the lake there is no need of locating the intake farther than two miles from the shore, where water can be obtained sufficiently free from suspended earthy

matter, and where a depth of about thirty feet is generally found, which is the least depth desirable for a submerged inlet.

GENERAL REMARKS.

After presenting the results thus far gained, indicating the general solution of the Chicago drainage and water supply problem, it remains to point out certain facts, which may be useful in discussing some of the legal measures required to carry out the proposed work. We desire to state that in order to reach the best results it is imperative to have all the main drainage works, such as intercepting sewers, water-ways and pumping stations, executed and maintained under a single management. It would be economical also to design and operate the main works for supplying water to the entire metropolitan area on a uniform plan and under one management, for the same reason that it is economical to keep the north and west side pumping works under one control, thus giving facilities as far as practicable for a supply proportioned to the demand, to the entire metropolitan area, including the towns not bordering on the lake. We do not wish to imply, however, that such a general authority need necessarily extend further than to the construction and maintenance of the tunnels and conduits furnishing water to the respective pumping works.

Regarding the limits for metropolitan drainage, the investigation has shown, as already indicated, that topographical conditions clearly define two districts for the future metropolis. The main district extends from the line of Eighty-seventh street on the south to the north line of Evanston, and from the lake westward to the Desplaines river. Its sewage is collected into one channel and discharged into the Desplaines valley at Summit. The Calumet district extends over the natural drainage area of Calumet lake and river, south of Eighty-seventh street, and has its outfall channel running from Blue Island to Sag.

The final report will contain several maps, showing certain features of the metropolitan area, namely, the distribution of the population in 1886, the existing works and main distribution pipes for water supply, and the existing main sewerage works and five feet contour lines over nearly the entire area.

It will also contain maps and profiles of the proposed waterways and storm-water diversion channels mentioned in the present report, and a map showing the lines of the main collecting and intercepting sewers of the proposed drainage districts, and also the lines of new tunnels and the general distribution of the water supply.

In carrying on the present investigation its various branches were placed in charge of the following gentlemen, of whose ability and industry we desire to make special mention: Mr. L. E. Cooley, principal assistant, had special charge of the hydrographic work; Mr. Charles H. Swan, of the sewage disposal on land; Mr. Francis Murphy, of the topographical work; Mr. O. Guthrie of the river pollution, land damages, etc.; and Mr. T. T. Johnston, of the water supply, sewerage and miscellaneous work.

Respectfully submitted.

RUDOLPH HERING,

Chief Engineer.

BENEZETTE WILLIAMS,

SAMUEL G. ARTINGSTALL,

Consulting Engineers.

CHAPTER XXVII.

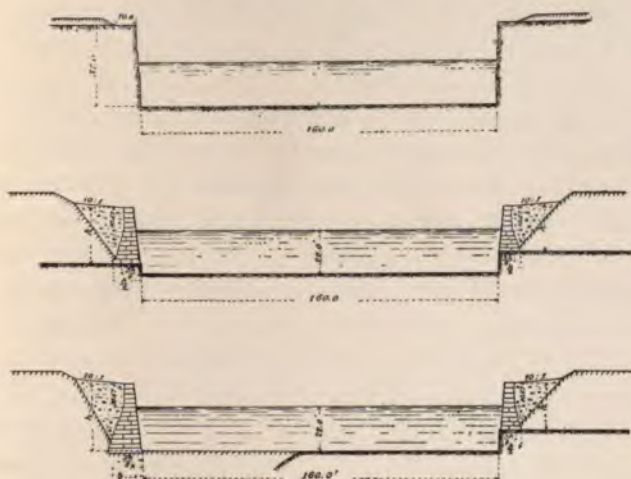
CHICAGO SANITARY DISTRICT CREATED.

Two bills were before the Illinois Legislature at its session of 1886-7 providing an adequate system of drainage for the city of Chicago. One of these was known as the Winston bill, which proposed to raise the money necessary to construct an outlet through the Desplaines valley by special assessment on the property to be benefited. The other has been known as the Hurd bill. It proposed to create a metropolitan district with power to issue bonds based on taxation to construct the required works.

It is related in a brief entitled "The Lakes and Gulf Waterway," published by the Chicago Citizens' association in 1888 and written by Lyman E. Cooley, that the joint committee of the Senate and the House to whom the bills were referred, "considered the question for several months, held many public sessions and heard much testimony on all the points at issue. The river cities from Joliet to Peoria organized to guard their interests and insisted that a channel should be specified not less than 160 feet wide and not less than 22 feet deep to carry not less than 600,000 cubic feet of water per minute. The Hurd bill as amended was reported favorably. Meantime, the question developed such broad relations and presented so many points of vital interest that a general conviction prevailed that the studies should be more fully concluded before legislation was effected and the bill was not pressed to a final vote."

Subsequently, the Act of June 6, 1887, was passed. This simply authorized the city of Chicago to construct a

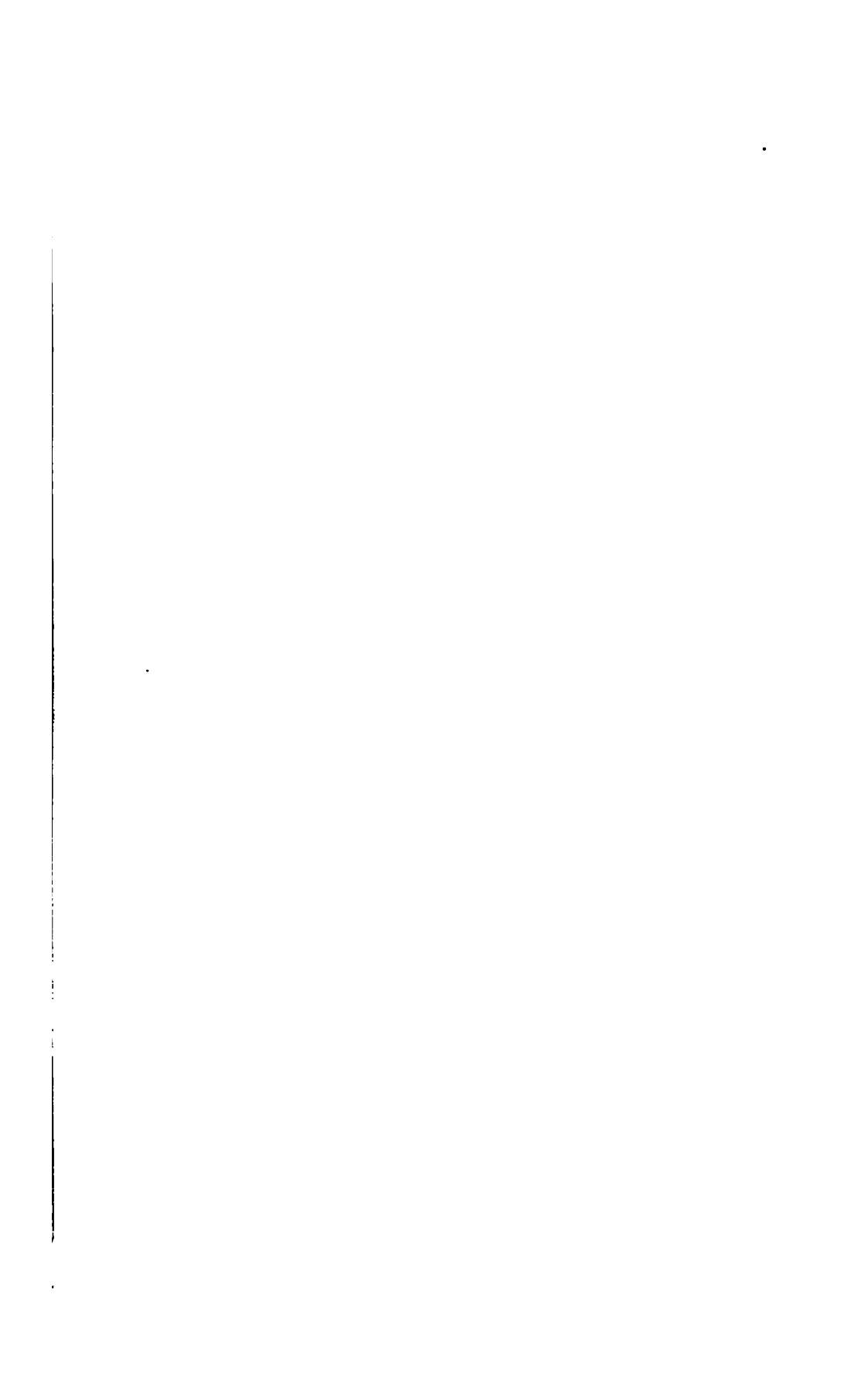
Cross Sections
— OF THE —
Channel in Rock.



Cross Sections
— OF THE —
Channel in Earth.



CROSS SECTIONS OF DRAINAGE CHANNEL AND WATERWAY.



cut-off north of the city for the diversion of the Desplaines river, or an excess above the ordinary water mark in that stream. No action has ever been taken under the authority conferred by this Act.

The first official step toward the enactment of the present drainage law was taken in the passage of a joint resolution introduced in the House by Thomas H. Riley of Will county, on May 26, 1887. This resolution provided for the appointment of a committee of five, consisting of the Mayor of Chicago, ex-officio, two members of the House to be appointed by the speaker, and two members of the Senate, to be appointed by the president of the Senate, whose duty should be to examine and report to the next session of the Legislature the subject of the drainage of Chicago and its suburbs. "If such commission shall find upon investigation," said the resolution, "that the most practicable solution of the problem is in the construction of a waterway for the sewage from Chicago to the Desplaines river at or near Joliet, the commission shall report what requirements should be made as to the construction of such waterway and the dilution of such sewage for the protection of the health and comfort of the people along the Desplaines river at and below Joliet." The commission was required to serve without pay, its expenses to be paid by the city of Chicago. The resolution passed the House at once and the Senate on May 31.

B. A. Eckhart of Chicago and Andrew J. Bell of Peoria were appointed members of the committee from the Senate, and Thomas C. MacMillan of Chicago and Thomas H. Riley of Joliet from the House. Mayor John A. Roche of Chicago was the fifth member of the committee, by virtue of his office.

The committee held many public meetings and had many conferences with the people living in the Desplaines and Illinois river valleys during the two ensuing years. As a

result of this interchange of opinion, a careful study of the necessities of Chicago and the interests of the inhabitants of the valleys, and by the aid of the best legal counsel, the committee reported on February 1, 1889, an Act creating the Chicago Sanitary District. "The commission," it said, "has diligently studied the subject submitted to it in all its sanitary and commercial aspects. It has visited and surveyed the territory sought to be improved. Conferences have been held with representatives from all the leading cities, towns and villages affected. An earnest spirit has been manifested to aid in the solution of this important problem. All plans proposed for meeting the demands of the river and valley communities and the pressing needs of Chicago have been carefully examined by this commission. The plan agreed upon by the commission, as set forth in detail in the bill which accompanies this report, is believed by the commission to be the most feasible, practicable and satisfactory method for all the varied interests involved."

While the bill was pending in the Legislature and when before the committee of the whole, arguments for and against it were heard from prominent citizens of Chicago and towns in the interior of the State. A delegation of citizens was sent from Joliet to Springfield to urge the passage of the bill, and resolutions advocating its passage were adopted by the business men of Marseilles and forwarded to the House.

After many amendments in the nature of concessions to the valley people the bill passed the House on April 11 by a vote of 92 to 42. After further amendments it was concurred in by the Senate on May 21 by a vote of 32 to 18. The Senate amendments were adopted by the House on May 24 by a vote of 97 to 39, and the bill received the signature of the governor on May 29. It was in force on July 1, 1889. The following is the text of the law:

186. INCORPORATING SANITARY DISTRICT—QUESTION, HOW SUBMITTED—COMMISSIONERS.] § 1. *Be it enacted by the People of the State of Illinois, represented in the General Assembly,* That whenever any area of contiguous territory within the limits of a single county shall contain two or more incorporated cities, towns or villages, and shall be so situated that the maintenance of a common outlet for the drainage thereof will conduce to the preservation of the public health, the same may be incorporated as a sanitary district under this act, in the manner following: Any 5,000 legal voters resident within the limits of such proposed sanitary district, may petition the county judge of the county in which they reside to cause the question to be submitted to the legal voters of such proposed district whether they will organize as a sanitary district under this act. Such petition shall be addressed to the county judge, and shall contain a definite description of the territory intended to be embraced in such district, and the name of such proposed sanitary district: *Provided, however,* that no territory shall be included in any municipal corporation formed hereunder which is not situated within the limits of a city, incorporated town or village, or within three miles thereof, and no territory shall be included within more than one sanitary district under this act. Upon the filing of such petition in the office of the county clerk of the county in which such territory is situated, it shall be the duty of the county judge to call to his assistance two judges of the Circuit Court, and such judges shall constitute a board of commissioners, which shall have power and authority to consider the boundaries of any such proposed sanitary district, whether the same shall be described in such petition or otherwise. Notice shall be given by such county judge of the time and place where such commissioners will meet, by a publication inserted in one or more daily papers published in such county, at least twenty days prior to such meeting. At such meeting the county judge shall preside, and all persons in such proposed sanitary district shall have an opportunity to be heard touching the location and boundary of such proposed district and make suggestions regarding the same, and such commissioners, after hearing statements, evidence and suggestions, shall fix and de-

termine the limits and boundaries of such proposed district, and for that purpose and to that extent, may alter and amend such petition. After such determination by said commissioners, or a majority of them, the county judge shall submit to the legal voters of the proposed sanitary district the question of the organization and establishment of the proposed sanitary district, as determined by said commissioners, at an election to be held on the first Tuesday after the first Monday in November thence next ensuing. Notice whereof shall be given by said commissioners, at least twenty days prior thereto, by publication in one or more daily papers published within such proposed sanitary district, such notice to specify briefly the purpose of such election, with a description of such proposed district. Each legal voter resident within such proposed sanitary district shall have the right to cast a ballot at such election, with the words thereon, "For Sanitary District," or "Against Sanitary District." The ballots so cast shall be received, returned and canvassed in the same manner and by the same officers as is provided by law in the case of ballots cast for county officers. The county judge shall cause a statement of the result of such election to be spread upon the records of the County Court. If a majority of the votes cast upon the question of the incorporation of the proposed sanitary district shall be in favor of the proposed sanitary district such proposed district shall thenceforth be deemed an organized sanitary district under this act.

187. JUDICIAL NOTICE OF DISTRICT—ORGANIZATION—ELECTION—COUNTY JUDGE.] § 2. All courts in this State shall take judicial notice of the existence of all sanitary districts organized under this act. Upon the organization of any sanitary district under this act the county judge shall call an election to elect officers and cause notice thereof to be posted or published, and perform all other acts in reference to such election in like manner as nearly as may be as he is required to perform in reference to the election of officers in newly organized cities under the provision of an act entitled "An act to provide for the incorporation of cities and villages," approved April 10, 1872.

188. TRUSTEES—ELECTION AND TERMS OF.] § 3. In each sanitary district organized under this act, there shall be elected

nine trustees, who shall hold their offices for five years, and until their successors are elected and qualified, except the term of office of the first trustees elected, shall be until five years after the first Monday in December after their election. The election of trustees after the first, shall be on the Tuesday next after the first Monday in November in every fifth year. In all elections for trustees each qualified voter may vote for as many candidates as there are trustees to be elected, or he may distribute his vote among not less than five-ninths of the candidates to be elected, giving to each of the candidates among whom he distributes the same, the same number of votes or fractional parts of votes. The trustees shall choose one of their number president, and such sanitary district shall from the time of the first election held by it under this act be construed in law and equity a body corporate and politic and by the name and style of the sanitary district of-----, and by such name and style may sue and be sued, contract and be contracted with, acquire and hold real estate and personal property necessary for corporate purposes, and adopt a common seal and alter the same at pleasure.

189. TRUSTEES CONSTITUTE A BOARD—DUTIES AND POWERS OF.] § 4. The trustees elected in pursuance of the foregoing provisions of this act shall constitute a board of trustees for the district by which they are elected, which board of trustees is hereby declared to be the corporate authorities of such sanitary district, and shall exercise all the powers and manage and control all the affairs and property of such district. Said board of trustees shall have the right to elect a clerk, treasurer, chief engineer and attorney for such municipality, who shall hold their respective offices during the pleasure of the board, and who shall give such bond as may be required by said board. Said board may prescribe the duties and fix the compensation of all the officers and employees of said sanitary district: *Provided, however,* that the salary of the president of said board of trustees shall in no case exceed the sum of four thousand dollars per annum; and the salary of the other members of said board shall not exceed three thousand dollars per annum. *And provided further,* that the amount received by any attorney shall

not exceed the sum of five thousand dollars (\$5,000) per annum. Said board of trustees shall have full power to pass all necessary ordinances, rules and regulations for the proper management and conduct of the business of said board of trustees and of said corporation, and for carrying into effect the objects for which such sanitary district is formed.

190. ORDINANCES MAKING APPROPRIATION — PUBLICATION OF.] § 5. All ordinances making any appropriations shall, within one month after they are passed, be published at least once in a newspaper published in such district, or if no such newspaper of general circulation is published therein, by posting copies of the same in three public places in the district; and no such ordinance shall take effect until ten days after it is so published, and all other ordinances, orders and resolutions shall take effect from and after their passage unless otherwise provided therein.

191. ORDINANCES AND RESOLUTIONS — EVIDENCE.] § 6. All ordinances, orders and resolutions, and the date of publication thereof, may be proven by the certificate of the clerk, under the seal of the corporation, and when printed in book or pamphlet form, and purporting to be published by the board of trustees, and such book or pamphlet shall be received as evidence of the passage and legal publication of such ordinances, orders and resolutions, as of the dates mentioned in such book, or pamphlet, in all courts and places without further proof.

192. BOARD OF TRUSTEES — POWERS OF.] § 7. The board of trustees of any sanitary district organized under this act shall have power to provide for the drainage of such district by laying out, establishing, constructing and maintaining one or more main channels, drains, ditches and outlets for carrying off and disposing of the drainage (including the sewage) of such district, together with such adjuncts and additions thereto as may be necessary or proper to cause such channels or outlets to accomplish the end for which they are designed in a satisfactory manner; also to make and establish docks adjacent to any navigable channel made under the provisions hereof for drainage purposes, and to lease, manage and control such docks, and also to control and dispose of any water-power which may be incident-

ally created in the construction and use of said channels or outlets, but in no case shall said board have any power to control water after it passes beyond its channel, waterways, races or structures into a river or natural waterway or channel, or water-power or docks situated on such river or natural waterway or channel: *Provided, however*, nothing in this act shall be construed to abridge or prevent the State from hereafter requiring a portion of the funds derived from such water-power, dockage or wharfage to be paid into the State Treasury to be used for State purposes. Such channels or outlets may extend outside of the territory included within such sanitary district, and the rights and powers of said board of trustees over the portion of such channel or outlet lying outside of such district shall be the same as those vested in said board over that portion of such channels or outlets within the said district.

193. MAY PURCHASE AND SELL REAL ESTATE, ETC.] § 8. Such sanitary district may acquire by purchase, condemnation, or otherwise any and all real and personal property, right of way and privilege, either within or without its corporate limits that may be required for its corporate purposes: *Provided*, all moneys for the purchase and condemnation of any property shall be paid before possession is taken, or any work done on the premises damaged by the construction of such channel or outlet, and in case of an appeal from the county court taken by either party whereby the amount of damages is not finally determined, the amount of judgment in such court shall be deposited at some bank to be designated by the judge thereof subject to the payment of such damages on orders signed by such county judge, whenever the amount of damages is finally determined; and when not longer required for such purposes, to sell, convey, vacate and release the same, subject to the reservation contained in section 7, relating to water-powers and docks.

194. MAY BORROW MONEY—LIMITATION.] § 9. The corporation may borrow money for corporate purposes and may issue bonds therefor, but shall not become indebted, in any manner, or for any purpose, to an amount in the aggregate to exceed five per centum on the valuation of taxable property therein, to be ascertained by the last assessment for State and county taxes

previous to the incurring of such indebtedness : *Provided*, however, that said five per centum shall not exceed the sum of fifteen million dollars (\$15,000,000).

195. TO PROVIDE FOR DIRECT ANNUAL TAX — NET EARNINGS.] § 10. At the time or before incurring any indebtedness, the board of trustees shall provide for the collection of a direct annual tax sufficient to pay the interest on such debt as it falls due, and also to pay and discharge the principal thereof as the same shall fall due, and at least within twenty years from the time of contracting the same : *Provided*, that the net earnings from water-power and docks may be appropriated and applied to the purpose of paying the interest or principal of such indebtedness, or both, and to the extent that they will suffice, the direct tax may be remitted.

196. CONTRACTS—HOW LET.] § 11. All contracts for work to be done by such municipality, the expense of which will exceed five hundred dollars, shall be let to the lowest responsible bidder therefor upon not less than sixty days' public notice of the terms and conditions upon which the contract is to be let having been given by publication in a newspaper of general circulation published in said district, and the said board shall have the power and authority to reject any and all bids, and re-advertise : *Provided*, no person shall be employed on said work unless he be a citizen of the United States, or has in good faith declared his intentions to become such citizen. In all cases where an alien after filing his declaration of intention to become a citizen of the United States shall for the space of three months after he could lawfully do so, fail to take out his final papers and complete his citizenship, such failure shall be *prima facie* evidence that his declaration of intentions was not made in good faith. And that eight hours shall constitute a day's work.

197. TRUSTEES MAY LEVY AND COLLECT TAXES, ETC.] § 12. The board of trustees may levy and collect taxes for corporate purposes upon property within the territorial limits of such sanitary district, the aggregate amount of which in any one year shall not exceed one-half of one per centum of the value of the taxable property within the corporate limits, as the same

shall be assessed and equalized for State and county taxes of the year in which the levy is made. Said board shall cause the amount required to be raised by taxation in each year to be certified by the county clerk, on or before the second Tuesday in August, as provided in section one hundred and twenty-two of the general revenue law. All taxes so levied and certified shall be collected and enforced in the same manner and by the same officers as State and county taxes, and shall be paid over by the officer collecting the same to the treasurer of the sanitary district, in the manner and at the time provided by the general revenue law.

198. EXPENSES OF IMPROVEMENT—SPECIAL ASSESSMENTS—GENERAL TAX.] § 13. The board of trustees shall have power to defray the expenses of any improvement made by it in the execution of the powers hereby granted to such incorporation, by special assessment or by general taxation, or partly by special assessment and partly by general taxation, as they shall by ordinance prescribe. It shall constitute no objection to any special assessment, that the improvement for which the same is levied is partly outside the limits of such incorporation, but no special assessment shall be made upon property situated outside of such sanitary district, and in no case shall any property be assessed more than it will be benefited by the improvement for which the assessment is levied. The proceedings for making, levying, collecting and enforcing of any special assessment levied hereunder, shall be the same as nearly as may be as is prescribed by article nine of an act entitled: "An act to provide for the incorporation of cities and villages," approved April 10, 1872. Whenever in said act the words "city council" are used, the same shall apply to the board of trustees constituted by this act, and the words applying to the city or its officers in that article shall be held to apply to the corporation hereby created and to its officers.

199. ASSESSMENT — INSTALLMENTS — INTEREST.] § 14. When any assessment is made under this act, the ordinance authorizing such assessment may provide that it be divided into equal annual installments, not more than twenty in number, and fix the amount and time of payment of each install-

ment, and that the installment shall bear interest at a rate not exceeding six per cent per annum, payable annually, from the date fixed in said ordinance, and the several installments and interests thereon may be collected and enforced, as they shall become due, in the manner provided for the enforcement of assessments under said Article 9. No more of any assessment need be returned or certified to the county collector than will show the amount due and unpaid at the time of such return, and no sale of any parcel of land for any installment of an assessment shall discharge the premises from any subsequent installment of the same or any other assessment. Any one or all of the installments may be paid any time after the assessment is confirmed, with accrued interest, if any, to the date of payment.

200. WHEN ASSESSMENTS PAYABLE BY INSTALLMENTS—BONDS MAY BE ISSUED.] § 15. Where any assessment is made payable in installments the board of trustees may issue bonds or certificates not exceeding in amount eighty per centum of the unpaid portion of such assessment at the date of the issue thereof, payable only out of such assessment, and bearing interest at a rate not exceeding the rate of interest upon the installments of such assessments. The board of trustees shall have the right to call in and pay off said bonds or certificates as fast as there is money received into the treasury from the assessment against which the same are issued, and all moneys received upon such assessment shall be applied to the payment of said certificates or bonds until they are fully satisfied.

201. PRIVATE PROPERTY—HOW TAKEN FOR IMPROVEMENT.] § 16. Whenever the board of trustees of any sanitary district shall pass an ordinance for the making of any improvement which such district is authorized to make, the making of which will require that private property should be taken or damaged, such district may cause compensation therefor to be ascertained, and condemn and acquire possession thereof in the same manner as nearly as may be as is provided in an act entitled “An act to provide for the exercise of the right of eminent domain,” approved April 10, 1872: *Provided, however,* that proceedings to ascertain the compensation to be paid for taking or damaging

private proerty shall in all cases be instituted in the county where the property sought to be taken or damaged is situated: *And provided*, that all damages to property whether determined by agreement or by final judgment of court shall be paid out of the annual district tax, prior to the payment of any other debt or obligation.

202. MAY ACQUIRE RIGHT OF WAY.] § 17. When it shall be necessary in making any improvements which any district is authorized by this act to make, to enter upon any public property or property held for public use, such district shall have the power so to do and may acquire the necessary right of way over such property held for public use in the same manner as is above provided for acquiring private property, and may enter upon, use, widen, deepen and improve any navigable or other waters, waterways, canal or lake: *Provided*, the public use thereof shall not be unnecessarily interrupted or interfered with, and that the same shall be restored to its former usefulness as soon as practicable: *Provided, however*, that no such district shall occupy any portion of the Illinois and Michigan canal outside of the limits of the county in which such district is situated for the site of any such improvement, except to cross the same, and then only in such a way as not to impair the usefulness of said canal, or to the injury of the right of the State therein, and only under the direction and supervision of the canal commissioners: *And, provided further*, that no district shall be required to make any compensation for the use of so much of said canal as lies within the limits of the county in which said district is situated, except for transportation purposes.

203. SPECIAL ASSESSMENT—DAMAGE TO PROPERTY, AND COST OF ACQUIRING.] § 18. In making any special assessment for any improvement which requires the taking or damaging of property, the cost of acquiring the right to damage or take such property may be estimated and included in the assessment as a part of the cost of making such improvement.

204. LIABILITY OF SANITARY DISTRICT FOR DAMAGES.] § 19. Every sanitary district shall be liable for all damages to real estate within or without such district which shall be overflowed

or otherwise damaged by reason of the construction, enlargement or use of any channel, ditch, drain, outlet or other improvement under the provisions of this Act; and actions, to recover such damages may be brought in the county where such real estate is situate, or in the county where such sanitary district is located, at the option of the party claiming to be injured. And in case judgment is rendered against such district for damage the plaintiff shall also recover his reasonable attorney's fees, to be taxed as costs of suit: *Provided, however*, it shall appear on the trial that the plaintiff notified the trustees of such district, in writing, at least 60 days before suit was commenced by leaving a copy of such notice with some one of the trustees of such district stating that he claims damages to the amount of . . . dollars, by reason of (here insert the cause of damage) and intends to sue for the same: *And, provided further*, that the amount recovered shall be larger than the amount offered by said trustees (if anything) as a compromise for damages sustained.

205. CAPACITY OF CHANNEL OR OUTLET.] § 20. Any channel or outlet constructed under the provisions of this act, which shall cause the discharge of sewage into or through any river or stream of water beyond or without the limits of the district constructing the same, shall be of sufficient size and capacity to produce a continuous flow of water of at least two hundred cubic feet per minute for each one thousand of the population of the district drained thereby, and the same shall be kept and maintained of such size and in such condition that the water thereof shall be neither offensive or injurious to the health of any of the people of this State, and before any sewage shall be discharged into such channel or outlet, all garbage, dead animals, and parts thereof, and other solids shall be taken therefrom.

206. SANITARY DISTRICT—FAILURE TO COMPLY WITH ACT—REMEDY—PENALTY.] § 21. In case any sanitary district in this State formed under the provisions of this Act shall introduce sewage into any river or stream of water, or natural or artificial watercourse, beyond or without the limits of such district without conforming to the provisions of this Act, or having introduced such sewage into such watercourse, shall

fail to comply with any of the provisions of this Act, an action to enforce compliance shall be brought by the Attorney General of this State in the courts of any county wherein such watercourse is situate, or he may authorize the State Attorney of any such county to commence and prosecute such action in any such county: *Provided*, that nothing in this section contained shall be construed to prevent the prosecution of any action or proceeding by individuals or bodies corporate or politic against such district.

207. ACT—HOW CONSTRUED.] § 22. Nothing in this Act contained shall be so construed as to constitute a contract or grant between the State of Illinois and any sanitary district formed under its provisions, or to prevent, debar or deprive the State of Illinois from, at any time in the future, altering, amending or repealing this Act, or imposing any conditions, restrictions or requirements other, different or additional to any herein contained upon any sanitary district which may be formed hereunder.

208. CHANNEL—HOW TO BE CONSTRUCTED.] § 23. If any channel is constructed under the provisions hereof by means of which any of the waters of Lake Michigan shall be caused to pass into the Desplaines or Illinois river, such channel shall be constructed of sufficient size and capacity to produce and maintain at all times a continuous flow of not less than 300,000 cubic feet of water per minute, and to be of a depth of not less than fourteen feet, and a current not exceeding three miles per hour, and if any portion of any such channel shall be cut through a territory with a rocky stratum where such rocky stratum is above a grade sufficient to produce a depth of water from Lake Michigan of not less than eighteen feet, such portion of said channel shall have double the flowing capacity above provided for, and a width of not less than one hundred and sixty feet at the bottom capable of producing a depth of not less than eighteen feet of water. If the population of the district draining into such channel shall at anytime exceed 1,500,000, such channel shall be made and kept of such size and in such condition that it will produce and maintain at all times a continuous flow of not less than 20,000 cubic feet of water per

minute for each 100,000 of the population of such district, at a current of not more than three miles per hour, and if at any time the General Government shall improve the Desplaines or Illinois rivers, so that the same shall be capable of receiving a flow of 600,000 cubic feet of water per minute, or more, from said channel, and shall provide for the payment of all damages which any extra flow above 300,000 cubic feet of water per minute from such channel may cause to private property so as to save harmless the said district from all liability therefrom, then such sanitary district shall, within one year thereafter, enlarge the entire channel leading into said Desplaines or Illinois rivers from said district to a sufficient size and capacity to produce and maintain a continuous flow throughout the same of not less than 600,000 cubic feet of water per minute, with a current of not more than three miles per hour, and such channel shall be constructed upon such grade as to be capable of producing a depth of water not less than eighteen feet throughout said channel, and shall have a width of not less than one hundred and sixty feet at the bottom. In case a channel is constructed in the Desplaines river as contemplated in this section it shall be carried down the slope between Lockport and Joliet to the pool commonly known as the upper basin of sufficient width and depth to carry off the water the channel shall bring down from above. The district constructing a channel to carry water from Lake Michigan of any amount authorized by this Act, may correct, modify and remove obstructions in the Desplaines and Illinois rivers, wherever it shall be necessary so to do to prevent overflow or damage along said rivers, and shall remove the dams at Henry and Copperas Creek in the Illinois river, before any water shall be turned into the said channel. And the canal commissioners, if they shall find at any time that an additional supply of water has been added to either of said rivers, by any drainage district or districts, to maintain a depth of not less than six feet from any dam owned by the State, to and into the first lock of the Illinois and Michigan Canal at La Salle, without the aid of any such dam, at low water, then it shall be the duty of said canal commissioners to cause such dam or dams to be removed. This Act shall not be construed to

authorize the injury or destruction of existing water power rights.

209. CHANNEL WHEN COMPLETED—CONTROL OF.] § 24. When such channel shall be completed, and the water turned therein, to the amount of three hundred thousand cubic feet of water per minute, the same is hereby declared a navigable stream, and whenever the General Government shall improve the Desplaines and Illinois rivers for navigation to connect with this channel, said General Government shall have full control over the same for navigation purposes, but not to interfere with its control for sanitary or drainage purposes.

210. MAY PERMIT TERRITORIES OUTSIDE TO DRAIN, ETC.] § 25. Any district formed hereunder shall have the right to permit territory lying outside its limits and within the same county to drain into and use any channel or drain made by it, upon such payments, terms and conditions as may be mutually agreed upon, and any district formed hereunder is hereby given full power and authority to contract for the right to use any drain or channel which may be made by any other sanitary district, upon such terms as may be mutually agreed upon, and to raise the money called for by any such contract in the same way and to the same extent as such district is authorized to raise money for any other corporate purposes: *Provided*, that where the united flow of any sanitary districts thus co-operating shall pass into any channel constructed within the limits of the county wherein such districts are located, and which passes into the Desplaines or Illinois rivers, such united flow shall in no case and at no time be less than 20,000 cubic feet of water per minute for each one hundred thousand of the aggregate of the population of the districts co-operating: *Provided*, nothing in this Act shall in any wise be so construed as to diminish, impair, or remove any right or rights of any city, village, township, or corporation, body politic or individual situated on the Desplaines or Illinois rivers or their tributaries and within the valleys of the same to use the channel for drainage or otherwise not inconsistent with the rights of the district constructing the same as expressed in this act.

211. WHEN CITY OR VILLAGE OWNS WATERWORKS, ETC.] § 26. Whenever in any such sanitary district there shall be a

city, incorporated town or village, which owns a system of waterworks and supplies water from a lake or other source which will be saved and preserved from sewage pollution, by the construction of the main channel, drain, ditch or outlet herein provided for, and the turning of the sewage of such city and district therein, and there shall be in such sanitary district any territory bordering on any such city, incorporated town or village within the limits of another city, incorporated town or village, which does not own any system of waterworks, at the time of the creation of such sanitary district, then upon application by the corporate authorities of such latter named city, incorporated town or village the corporate authorities of such city, incorporated town or village having such system of waterworks shall furnish water at the boundary line between such municipalities by means of its waterworks to the corporate authorities asking for the same in such quantities as may be required to supply consumers within said territory, at no greater price or charge than it charges and collects of consumers, within its limits for water furnished through meters in like large quantities.

212. WHEN CHANNEL CONSTRUCTED—COMMISSIONERS TO BE APPOINTED TO INSPECT ITS WORK.] § 27. If any channel shall be constructed under the provisions of section 23 of this Act, it shall be the duty of the trustees of such district, where such channel shall be completed, and before any water or sewage shall be admitted therein, to duly notify, in writing, the Governor of this State of such fact; and the Governor shall thereupon appoint three discreet persons as commissioners, one of whom shall be a resident of the city of Joliet, or between said city and the city of La Salle, and one a resident of the city of La Salle, or between said city and the city of Peoria, and one a resident of the city of Peoria, or between said city and the mouth of the Illinois river, to inspect said work. The said commissioners shall, within ten days after such appointment, meet at the city of Chicago and shall appoint a competent civil engineer, and they may employ such other assistance as they may require to expeditiously perform their duties. The said commission shall take as their datum line for the survey the datum

established by the Illinois and Michigan Canal Trustees in 1847, and shall make such examination and surveys of Chicago river and of the channel or channels authorized by this Act as shall enable them to ascertain whether said channel is of the character and capacity required by this act. And in case they shall find the work in all respects in accordance with the provisions of section 23 of this Act, they shall so certify to the Governor, who shall thereupon authorize the water and sewage to be let into said channel. But in case said commissioners shall find said channel is not constructed in accordance with the provisions of this Act, it shall be their duty to file in any court of competent jurisdiction, on the chancery side thereof, in their name as such commissioners, a bill against said corporation, which bill shall set forth wherein said work is deficient and fails to comply with the provisions of this Act; and said court shall thereupon issue an injunction without bond against said defendant, enjoining and restraining it from admitting water or sewage into said channel until the final order of the court. And in case said court upon hearing shall determine that said channel is not constructed in accordance with the provisions of this Act, said injunction shall be continued until the provisions of this Act shall have been fully complied with.

Such commissioners and engineer shall receive for their service ten dollars per day each, and their reasonable expenses and outlays for the time by them necessarily employed in the discharge of their duties, which shall be paid to them from the State treasury; and the said sanitary district shall reimburse the State for all expenses and disbursements on account of said commission.

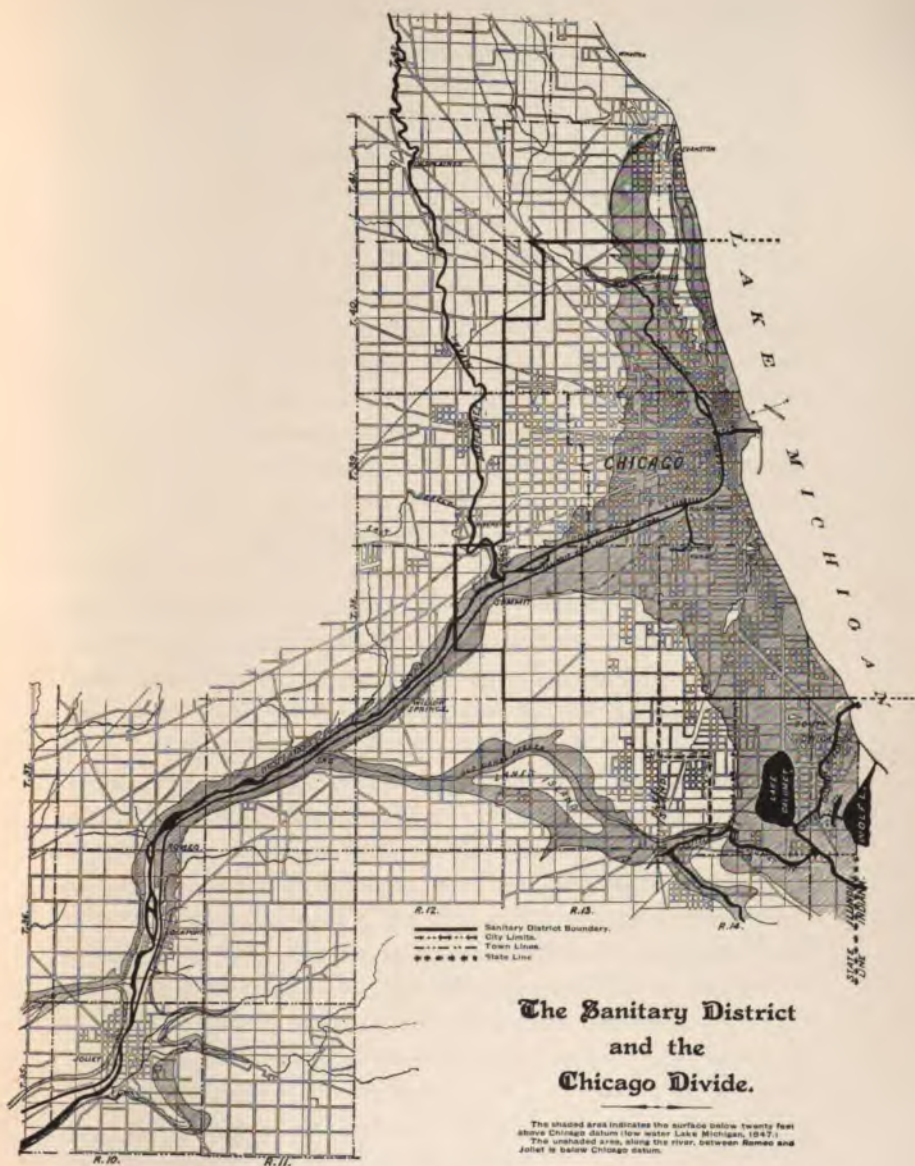
If any channel is constructed under the provisions of this Act which shall discharge the sewage of a population of more than 300,000 into or through any river beyond or without the limits of the district constructing it, the same shall be constructed in accordance with the provisions of section 23 of this Act, and if any such channel receives its supply of water from any river or channel connecting with Lake Michigan it shall be construed as receiving its supply of waters from Lake Michigan.

CHAPTER XXVIII.

ORGANIZATION OF THE SANITARY DISTRICT.

Petitions were prepared soon after the passage of the Sanitary District law, addressed to Hon. Richard Prendergast, County Judge of Cook County, asking him to cause to be submitted to the legal voters of the proposed Sanitary District of Chicago the question of organization. More than the requisite five thousand signatures were readily obtained. The petition was submitted on August 15, 1889. Judge Prendergast requested Judges Richard S. Tuthill and Samuel P. McConnell of the Circuit Court to sit with him as Commissioners. The Commission met on September 18, and heard arguments for and against the proposed boundaries of the District. Several subsequent meetings were held and on October 14 the Commission fixed the boundaries as follows :

“ Beginning at the shore of Lake Michigan at Eighty-seventh street, the same being the township line between townships thirty-seven (37) and thirty-eight (38) north, range fifteen (15) east of the principal meridian, and running thence westerly on said township line to range line between ranges thirteen (13) and twelve (12); thence north on said range line to two (2) miles to the southwest corner of section nineteen (19), township thirty-eight (38), range thirteen (13); thence west on south line of sections twenty four (24) and twenty-three (23) to the southwest corner of said section twenty-three (23) township thirty-eight (38) north, range twelve (12) east; thence north along the west line of sections twenty-three (23),



CHICAGO SANITARY DISTRICT AND DESPLAINES VALLEY.

fourteen (14), eleven (11) and two (2) of township thirty-eight aforesaid, range twelve (12) east to the northwest corner of said section two (2); thence east on the north line of sections two (2) and one (1), the same being the township line between townships thirty-eight (38) and thirty-nine (39) north, range twelve (12) east, to the south line of Ogden avenue; thence in an easterly direction along said south line of Ogden avenue, the same being part of the boundary of the village of Lyons, to the range line between ranges twelve (12) and thirteen (13) east, the same being the west line of the town of Cicero; thence north on said range line to the northwest corner of section nineteen (19), township forty (40) north, range thirteen (13) east; thence east to southwest corner of the east half of section seventeen (17), township forty (40) north, range thirteen (13) east; thence north through the middle of sections seventeen (17), eight (8) and five (5) of said township and range to the boundary of the tract known as Caldwell's Reserve; thence northwesterly along said boundary line to the township line between townships forty (40) and forty-one (41) north, range thirteen (13) east; thence easterly along said township line, the same being the northern boundary of the City of Chicago and formerly the northern boundary of the Village of Jefferson and the City of Lake View, to the shore of Lake Michigan; thence easterly in continuation of said township line to a point three miles from the shore of Lake Michigan measured at right angles to said shore; thence southerly and parallel to the shore of Lake Michigan and three miles distant therefrom to the north boundary of the State of Indiana; thence west along said boundary to the northwest corner of said State; thence south along the west boundary of said State to a point due east of the point of beginning; thence west to the point of beginning."

The Commissioners having fixed the boundaries of the

proposed Chicago Sanitary District, Judge Prendergast issued an order on October 14 requiring that the question of the establishment of the district be submitted to the people at the election to be held on November 5, 1889. The vote was as follows : For, 70,958 ; against, 242.

Compared with the boundaries of the City of Chicago those of the Sanitary District were as follows: On the north they were identical—along North Seventy-first street. Beginning at the northwest corner of the city limits the boundary line of the Sanitary District followed that of the city southward along an irregular line to the intersection of Irving Park boulevard and West Seventy-second street. At this point the boundaries separated, that of the district continuing south along the line of West Seventy-second street to Thirty-ninth street, taking in the town of Cicero. The course was then westward two miles along Thirty-ninth street, south four miles and east again to West Seventy-second street, including Summit and the bend in the Desplaines river where the usual spring overflows occurred. A turn again to the southward along West Seventy-second street, along which the boundary ran for two miles, brought it to Eighty-seventh street. The boundary continued eastward along Eighty-seventh street to the lake shore. The eastern boundary of the Sanitary District was located in Lake Michigan three miles from shore, thus giving the District control over the discharge of sewers into the lake.

Considerable territory west of the city limits was included in the Sanitary District, but the so-called Calumet region in the southern part of the city was excluded. A statement made by A. V. Powell, civil engineer, before the Commission on September 24 contains the reasons, substantially, for its exclusion. He called attention to the fact that the basin drained by the Calumet river had an area of 825 square miles, and that three-fifths of it was in Indiana. The rim of the basin on the south had an average elevation of

250 feet above Lake Michigan, except at the Sag. The tributaries of the Calumet river ran through valleys which gave a rapid discharge to the rainfall. The head of the Little Calumet river was in La Porte County, Indiana, ten miles southeast of Michigan City. The river ran in a westerly direction until it crossed the State line in Thornton township, and then northwest. The Grand Calumet received its water from a limited area adjoining the lake shore. Except in flood times it had no current. Its length was about twenty miles. The Grand Calumet and Little Calumet united near the south line of the City of Chicago to form the Calumet river which emptied into Lake Michigan at South Chicago. The land on either side of the Calumet river was low, averaging not more than $4\frac{1}{2}$ feet above the lake, and the greater part of it, some fifteen square miles, lying within the city limits, was subject to overflow in flood time.

No sewers emptied into Lake Michigan south of Fifty-sixth street to the Indiana state line. The total population having sewerage facilities and discharging sewage into the Calumet river was 1,500. The only sewer emptying into the Calumet river was in Ninety-second street. Pullman had a separate system of sewerage. There were no manufactories upon the line of the Calumet river that produced filth. The only filth-producing establishment within the basin was one slaughter-house at Hammond. This was twelve miles from Lake Michigan. *

Whenever a general system of sewerage should become necessary for this district it would be entirely practicable to adopt the separate system, either in conjunction with the territory adjacent to the State of Indiana, or without it, and treat the sewage by land purification. Land for this purpose could be secured near Hammond, and the purified water returned to the river would aid its flow. Whatever plan might be adopted, the sewage for the entire area south

of Eighty-seventh street would have to be pumped to a higher level.

If the same plan were adopted as for the Chicago basin a channel must be cut through the Sag. One inch of rainfall in the Calumet basin was the equivalent of 2,323,200 cubic feet of water per square mile. This would produce a flow for the basin of 1,331,000 cubic feet per minute, more than twice the maximum capacity of the channel provided for the Chicago basin. The reports of the United States Weather Bureau showed a yearly precipitation from 1872 to 1889 of 36 inches. In 125 days more than one inch fell in twenty-four hours. In one instance the precipitation was 6.19 inches in twenty-four hours.

The distance from the Calumet river along the line of the Stony creek feeder was seventeen miles. A profile made from the surveys of General Wilson showed that there were twelve miles of rock cutting. Hering's estimate from this profile was \$13,300,000, the cost of a channel with a capacity of 300,000 cubic feet per minute. Mr. Powell believed that the cost of the Sag channel would equal that of the Chicago channel.

The Sanitary District of Chicago is eighteen miles long from north to south, and about nine and one-half miles wide on a line passing through the court house in Chicago. Its extreme width is about fifteen miles. The District contains about 185 square miles.

On December 12, 1889, following the general election at which the Sanitary District was established, a special election was held for the selection of trustees. The successful candidates were John J. Altpeter, Arnold P. Gilmore, Christopher Hotz, John A. King, Murry Nelson, Richard Prendergast, W. H. Russell, Frank Wenter and H. J. Willing.

The first meeting of the Trustees was held on January 18, 1890. At the third meeting, held on February 1,

Trustee Nelson was elected president; Austin J. Doyle, clerk; Byron L. Smith, treasurer; L. E. Cooley, chief engineer; S. S. Gregory, attorney, and Charles Bary, secretary. The salary of the president was fixed at \$4,000 per annum, and that of each of the other trustees \$3,000. Other salaries were as follows: Clerk, \$6,000; treasurer, \$5,000; chief engineer, \$6,000; attorney, \$5,000, and secretary, \$1,500. The clerk was required to give bonds in the sum of \$200,000; the treasurer, \$500,000; chief engineer, \$100,000; attorney, \$100,000, and secretary, \$20,000.

At one of the early meetings a corporate seal was adopted, representing the State of Illinois, with Lake Michigan on the northeast, the Mississippi river on the west and the proposed waterway connecting these two bodies of water by way of the Desplaines and Illinois rivers. On a section of the new channel there were also shown a lake sailing vessel and a Mississippi river steamboat. The location of Chicago, Springfield and St. Louis was indicated.

Steps were taken at an early date to test the validity of the law. Two suits were brought against the Trustees of the Sanitary District, one by Marshall J. Wilson, and the other in the name of the people. The first was a bill for an injunction and sought to restrain the Board of Trustees from selling bonds, an ordinance for which had been adopted. It was alleged that the Sanitary District could only be vested with power, under the Constitution of the State, to make improvements by special assessments upon the property benefited. It could not, therefore, issue bonds to be paid by general taxation. The bill was dismissed by Judge Oliver H. Horton, presiding in the Circuit Court of Cook County, before whom the hearing was had.

An appeal was at once taken to the Supreme Court. An opinion affirming the decision of the lower court was filed at Ottawa on June 12, 1889. In this opinion, delivered by

Justice Scholfeld, the Court said three general questions were involved in the contentions :

Is it within the power of the General Assembly, under the Constitution, to authorize the formation of sanitary districts, disregarding the existence and boundaries of pre-existing municipal corporations, and invest their corporate authorities with powers of general taxation for sanitary purposes?

If this shall be answered in the affirmative, are the corporate authorities of such districts limited in the amount of indebtedness which they may incur under the Constitution, by the amounts of pre-existing indebtedness of other municipal corporations covering the same, or a part of the same territory?

Is the Act, under which the district whose corporate authorities are here sought to be enjoined was formed, local or special legislation within the prohibition of the Constitution?

In the opinion of the Supreme Court the Constitution of the State was not to be regarded as a grant of power to the legislative department ; on the contrary, it was to be taken as a limitation upon its powers. The Constitution, in providing for the organization of counties and county government, also contemplated that there would be local governments for public purposes, designated as cities, towns, villages, school districts and other municipal corporations. But there was no specification of the powers that should be conferred upon either, and no prohibition of the withdrawal of powers once conferred, and thereafter conferring them upon another.

If the Legislature might vest the power in cities, towns and villages to construct sewers, drains, etc., for sanitary purposes, and might also create a corporation within the county and invest it with like power, it followed that it might create a corporation including both city and county

and invest it with power to secure the public health by means of sewers and channels or drains.

There were no constitutional restrictions as to the boundary lines of public or municipal corporations within which new corporations might be formed, except as to counties. It was wholly unnecessary that the corporate authorities of the new corporation should be also the corporate authorities of some specific pre-existing corporation. So it would violate no principle of constitutional law to create a district and vest it with the powers of taxation for sanitary purposes, co-extensive with the territory to be controlled. The propriety of the creation of such a municipal corporation belonged alone to the General Assembly, and not to the courts.

The preservation of health was one of the paramount objects of government. It belonged to the police power, subject to the proper exercise of which either by the State Legislature, or by public corporations, to which the Legislature might delegate it, every citizen holds his property. The police power, so far as it related to the public health, included the making of sewers and drains for the removal of garbage and filth, the boring of artesian wells and the construction of aqueducts for the purpose of procuring a supply of pure, fresh water, the drain of malarious swamps and the erection of levees to prevent overflows.

The Constitution of 1870 authorized the Legislature to invest cities, towns and villages with power to make local improvements by special assessment, or by special taxation of contiguous property, or otherwise, and also provided that for all other corporate purposes all municipal corporations might be vested with authority to assess and collect taxes, etc. The words "municipal corporations," in this connection, were used in their ordinarily accepted and more enlarged sense of public, local corporations, exercising some governmental functions.

It was manifest that the first clause of section 9 of article 9 of the present Constitution was adopted to remove restrictions of the power of the General Assembly held to exist under the Constitution of 1848, and to enable the General Assembly to authorize the making of local improvements by the levy of the cost on contiguous property according to its frontage.

The words "local improvements," in that section of the Constitution which declares that "the General Assembly may vest the corporate authorities of cities, etc., with power to make local improvements by special assessment, or by special taxation of contiguous property, or otherwise," meant improvements that could be made by special assessment. Whether an improvement was of that character that it could be made by special assessment was a question of fact, not of law. The words "special assessment" were used to express the mode of making a local improvement in contradistinction to that by general taxation. The words "for other corporate purposes" meant "for other corporate purposes than those of local improvement by special assessment, or by special taxation of contiguous property," because it was the manner of making local improvements and not the fact of making them that was the subject of the first clause.

The Constitution was intended to cover the entire field of taxation,—the first clause, that of making local improvements by a mode different from that of general taxation, in which the cost of the improvements is assessed against the property actually or presumptively benefited thereby; and the second clause, that of general taxation, in which the rule of uniformity as to persons and property taxed shall be observed.

Since the adoption of section 31 of article 4 of the Constitution, drainage districts, as well as cities, towns and villages, could make local improvements by special assess-

ments, but not by special taxation of contiguous property. Section 22 of article 4 did not prohibit the formation and regulation of municipal corporations, other than cities, towns and villages, by special legislation. The prohibition of such legislation did not apply to drainage districts or sanitary districts.

The constitutional limitation upon the extent of corporate indebtedness applied to each municipal corporation singly. Where one such corporation might partially embrace the same territory as others, it might contract corporate indebtedness without regard to the indebtedness of any other corporate body embraced wholly or in part in its territory.

The second suit was in the nature of a quo warranto filed by the State's Attorney of Cook County against the Trustees of the Sanitary District in the Circuit Court of Cook County. Judgment was entered by Judge Julius S. Grinnell that the information be dismissed. An appeal was taken to the Supreme Court, as in the other case, and an opinion was filed also on June 12 affirming the judgment of the lower court.

Justice Bailey, in delivering the opinion, said the only questions presented to the court were those which involved the validity of the Act under which the Sanitary District was organized. The grounds upon which the constitutionality of the Act was assailed were summarized as follows :

1. That the title of the Act expresses and the Act embraces more than one subject.
2. That the Act embraces various subjects which are not expressed in the title.
3. That the Act is a local or special Act.
4. That it provides for cumulative voting at the elections of the trustees of the sanitary districts organized under it.
5. That in providing the machinery for the organization of sanitary districts, the Act imposes upon the judge

of the County Court and two judges of the Circuit Court, duties which are incompatible with their duties and functions as judges of those courts.

6. That the Act is an evasion of the constitutional provision which limits the indebtedness which a municipal incorporation shall be allowed to incur in any manner and for any purpose to five per centum of the value of the taxable property therein.

7. That the municipal authorities of sanitary districts are vested with the power of general taxation, and are not limited to special assessments upon the property benefited for the payment of the drainage system which they are authorized to construct.

Of these propositions the third, sixth and seventh were considered sufficiently answered in the Wilson decision.

As to the title and the restrictions under it, the generality of an Act was not objectionable so long as it was not made to cover legislation incongruous in itself. The Legislature must determine for itself how broad and comprehensive should be the object of a statute and how much particularity should be employed in the title defining it. It was purely a matter of legislative discretion whether the subject expressed should be general or specific. Where an Act embraces two subjects, both of which are expressed in the title, the entire Act must be held void. If there is but one subject, the Act is valid, although the subject may be composed of many parts and all of them are enumerated in the title. So in the Act of 1889, entitled "An Act to create Sanitary Districts and to remove obstructions in the Des-plaines and Illinois rivers," the general subject expressed is the creation of sanitary districts, and the removal of obstructions in the rivers named is so far germane to that subject as to constitute a part of it. There is, therefore, but one subject expressed in the title.

A sanitary district is a municipal corporation, organized

to secure, preserve, and promote the public health. Any subsidiary measure having a greater or less tendency to promote that object, or to advance the general scheme by which it is proposed, through the agency of such organization, to preserve and protect the public health, is germane to the general subject of the Act. All corporations in this country are the creatures of the legislative power, and it necessarily follows that the determination as to what shall be their constitution, objects and powers, is a matter wholly within the legislative discretion. Any measures authorized which are calculated to promote the object of the corporation may be said to be embraced in the title.

Where a sanitary district is formed to construct a system of drainage which in its results will necessarily affect certain rivers and canalways by largely increasing the volume of water therein, provisions of the Act creating the district which impose duties upon the district to take proper steps to prevent injury to others by such increased flow of water, are a necessary part of the general system of drainage for sanitary purposes, and within the object expressed in the title of the Act.

As the primary object of the law for the formation of the Sanitary District was for drainage for sanitary purposes, it was not subject to the charge of a duplicity of objects. Every intendment is in favor of the validity of the act.

The corporation might utilize the privileges derived from water power and docks as a source of revenue for the purpose of paying its indebtedness, incurred in constructing a channel for drainage purposes.

It was competent for the Legislature to establish, as a rule of public policy, that none but citizens, or those who in good faith have taken the preliminary steps to secure naturalization, shall be employed thereon, and also to establish a test by which the good faith of persons declaring their intentions to become citizens may be determined.

The proviso in the Act which required a portion of the funds derived from the water power, etc., at the will of the State, should be paid into the State treasury, was not a violation of the Constitution in compelling the people of one class of municipal corporations to pay more than their share of the burdens of the State government. The proviso did not attempt to divert any of the revenues of the District, but merely declared that the State was not concluded from requiring payment to be made to it.

The provision relating to cumulative voting was not in violation of any constitutional provision relating to suffrage, since the cumulation of votes was not made necessary.

An Act of the Legislature giving the Circuit or County Courts the power to appoint commissioners was a valid law. Powers and duties imposed by statute upon a circuit judge, not incompatible with his duties as a judge, might be rightfully exercised by him, as celebrating marriages and taking the acknowledgment of deeds.

Every presumption was in favor of the validity of a statute, and every reasonable doubt must be resolved in favor of its constitutionality. The courts would never declare a statute void except in a clear case. Whenever an Act of the Legislature could be so construed and applied as to avoid a conflict with the Constitution and give it the force of law, such construction should be adopted.

CHAPTER XXIX.

TIME AND MONEY NEEDLESSLY WASTED.

In spite of the fact that the Trustees were aided by the most favorable circumstances, no progress was made for more than two years. More than half a million dollars was spent without a single valuable result. No public body was ever more happily situated than the Drainage Board. It was charged with the execution of a work upon which the welfare and little less than the very existence of the city depended. The demand for this work by the people was almost unanimous. The law was adequate and its constitutionality definitely established. Resources were abundant. Yet time was frittered away and some of the Trustees sought to tamper with the law.

Most effusive pretensions were made at the outset. Soon after the publication of the opinions of the Supreme Court, the Board of Trustees addressed a communication to the United States senators and representatives from Illinois soliciting a conference with the proper committees in Congress on the subject of appropriations in the river and harbor bill. The Trustees wanted the bill to include "an item or appropriation for the securing of such information by the General Government as would enable it to determine upon the feasibility and value from a national standpoint of such work as might be required to build so as to provide a waterway between Lake Michigan and the Mississippi river via the Chicago, Desplaines and Illinois rivers."

On June 18 the chief engineer was instructed to make such surveys and other investigations between the Chicago

river and its south branches and forks and Summit as would enable the Trustees to select one of not less than four routes for a channel of the dimensions required by law; also, to make like investigations for like purposes between Summit and Lake Joliet, and make "further examination to enable him to inform the Board of the relation of the channel and works aforesaid to the Sanitary District, and to all the territory to be affected, beneficially or otherwise, by the construction and operation of said channels and works."

Under these comprehensive instructions Chief Engineer Cooley laid plans of great thoroughness and proceeded to execute them. Some of the members of the Board then objected to the expense and a protest was sent to Mr. Cooley on August 12 by President Nelson. Mr. Nelson did not see the importance of setting gauges for the study of the water discharge at various points in the Desplaines valley and elsewhere. "It is quite apparent," he said, "that we differ as to the practical utility of that work, and as I am quite convinced in my own mind that it is an expense which should certainly be deferred, if not avoided entirely, I respectfully suggest that the expense be stopped."

In his reply Mr. Cooley reminded the Board that the work was virtually required under his instructions and entered a counter protest. The episode is of interest as the first public expression of a difference which led to the resignation of Mr. Cooley.

The scope of Chief Engineer Cooley's plans is shown in his first report, dated September 17, 1890. He said all the field surveys and investigations contemplated between the South branch and its forks and Summit would probably be concluded during the month of October. Operations in some branches of the work were already beyond Summit. It was intended to continue the borings in the Desplaines valley during the winter. A reconnaissance of the Illinois valley was in rapid progress. Some attention would be

given to the tributaries of the Illinois river. All this work was regarded as of first importance in view of its probable effect in legislative issues. A comprehensive investigation of the flood conditions in the watersheds of the Desplaines and Chicago rivers had been undertaken. Gauging stations had been prepared and would be occupied as occasion demanded. Flood marks were being looked up and properly referred. The distribution of population from the census enumeration had been undertaken, and a map was being made showing the location of all the sewers in the district. Incidentally, some attention was being given to the distribution of marine commerce. Hydraulic investigations in regard to the proposed channel were under way, and measurements were being projected to determine the capacity of the present canal and its hydraulic elements. A topographical reconnaissance had been undertaken of the territory north and west of the Sanitary District; this was nearly completed. It was intended also to cover the territory to the south and through and adjacent to the Sag and the Calumet region. A systematic investigation of the sewage product of the South fork had been projected. That of other sections of the harbor and the pollution of the Desplaines and Illinois rivers would be taken up later.

"A work of this magnitude," said Mr. Cooley, "demands the most careful and thorough work, and all work hitherto undertaken or projected is upon the most comprehensive scale and by the most exact methods. It is proposed to leave nothing to guess work or assumption. The margin of certainty to be reached and the saving which may follow such a course ranges in the millions."

The Board became impatient and a resolution was passed on September 9, directing the chief engineer to file within thirty days such a report as would enable the Trustees to locate a route as far as Summit. On October 15, Mr. Cooley replied that he was unable to comply with the order.

A month later the committee on engineering reported that there had been, in the opinion of the committee, a lack of concentration of forces on the route between Chicago and Summit over which the Board desired to locate the line of the channel at the earliest practicable moment. The Committee recommended the appointment of a consulting engineer. On November 19 the chief engineer was instructed to suspend all work on the upper Desplaines river, except gauges, and all work outside the district and below Joliet, and to make additional surveys and borings between Chicago and Summit, if necessary, and make such compilations as would enable the Board to locate any one of four routes for the main channel between Chicago and Summit. The magnitude of the work would not permit the easy and off-hand solution of the problems allotted to the chief engineer which the Board seemed to expect, and the conflict between undue haste and justifiable deliberation terminated in the resignation of Mr. Cooley from the position of chief engineer on December 10. General John Newton was elected consulting engineer on the same date and a week later William E. Worthen was chosen to succeed Mr. Cooley as chief engineer.

At the annual election held on December 2, 1890, Richard Prendergast was elected president of the Board of Trustees. In his opening message Mr. Prendergast spoke in impressive terms of the magnitude of the enterprise which had been entrusted to the Board. The Board would not change in the slightest particular, he said, the dimensions or scope of the works that the necessities of the case or the law commanded it to carry out. "Indeed, the membership of this Board," he continued, "or the major portion of it, for whom perhaps I may more rightfully speak, were drawn to accept the duties and responsibilities of membership in this Board because they were firm believers in the utility, the grandeur and the feasibility of the whole project of establish-

ing a commodious waterway between the waters of the Great Lakes and the Mississippi river and the Illinois river valleys. Of that project the work committed especially to this Board forms a most important part and an indispensable link. All this is an additional advantage to the immediate purpose and scope of the works which are to be constructed for sanitary reasons only."

President Prendergast insisted that the Board must interpret the law of the Sanitary District strictly. "The very corporate seal of the Sanitary District of Chicago, every time it is used," he said, "stamps the charge that there is an intention on the part of this Board to deviate from the law in respect to the dimensions of the channel as a falsehood." The people had agreed to tax themselves for the construction of the work voluntarily and with practical unanimity. The commercial benefits to be derived from the enlarged waterway were indicated by the President.

Two months later the Board addressed a statement to the citizens of the Sanitary District urging an amendment of the law by which the cost of construction of the channel could be reduced. Engineers Newton and Worthen had submitted a preliminary report on January 10, 1891, and a more complete one on February 21. These reports indicated that the cost of construction of the smallest channel permitted by the law,—fourteen feet in depth through the earth and eighteen feet in the rock,—would be \$22,700,000. Auxiliaries would increase the cost to \$26,800,000. The statement of the Trustees declared that there was no provision under the law for raising such a sum, and it was not contemplated that the work would cost so much. Requiring a cut of eighteen feet through the rock involved a cost which was wholly unnecessary. Until the General Government should take steps to create a channel in the Desplaines and Illinois rivers which would take care of the amount of

water which the larger drainage channel would supply, it was unnecessary to make so deep a cut in the rock.

“The theory of the law is,” said the statement, “that a flow of 300,000 cubic feet per minute is ample for all purposes of sanitation and dilution, and will afford a channel for navigation which will probably not be met at its southern terminus, at or near Joliet, by a similar channel during this generation, and possibly never,—that is, as long as the present conditions continue. Therefore, we say that a channel can be constructed of ample width and depth to flow 300,000 cubic feet per minute where a saving in the rock cut alone will be from \$7,000,000 to \$10,000,000 and therefore with a corresponding saving in the earth cut.”

It was insisted that this recommendation did not trench upon the policy of a commercial waterway through the Illinois river valley. On the contrary, its adoption would do two things: Immediately there would result a channel to Joliet much greater for the purposes of a commercial waterway than its lower connection, the Illinois river, and the construction of the smaller channel would promote the project so far as it depended upon federal legislation. The address was signed by Trustees Prendergast, Gilmore, Hotz and Willing and George W. Smith, who had succeeded Mr. Gregory as attorney of the Board. It was adopted in open Board by the four trustees named, Trustee Wenter voting in the negative and Trustee Altpeter being excused from voting.

The following were the alterations in the law suggested: “Amend section 17 by omitting the language limiting the use of the Illinois and Michigan canal to that part within the County of Cook. Amend section 20 by striking out ‘two hundred cubic feet per minute for each one thousand of the population’ and inserting ‘sufficient to carry off and dilute all the sewage which shall flow or be caused to flow into the Illinois and Michigan canal or the Chicago river, and

to provide a navigable waterway commensurate with the greatest constant capacity now or hereafter attainable in the Illinois river. The channel herein provided for to be of at least equal capacity for purposes of flowing of water with the South branch of the Chicago river.' Amend sections 23, 24 and 27 by making them correspond with section 20 as above amended."

The attempt to amend the law did not meet with favor among the people and the Legislature declined to take the action as requested, notwithstanding some of the Trustees personally urged it.

Time passed and still no advance was made toward the construction of the main channel. The Board was subjected to severe criticism by public and press and it was charged that preparations for the work were purposely delayed. Trustees Nelson and King tendered their resignations as members of the Board on August 26, 1891, and Trustee Willing on September 23 following.

The vacancies created by these resignations were filled on November 3 by the election of William Boldenweck, Lyman E. Cooley, formerly chief engineer, and Bernard A. Eckhart. Trustee Wenter was elected president to succeed Richard Prendergast and those in favor of proceeding with the work as prescribed by law were now a majority. An effort in the line of progress was promptly followed by the resignation of Trustee Hotz, on January 16, 1892. The vacancy created by the resignation of Trustee Hotz was not filled until after the inauguration of work on the main channel, the law having made no provision for a special election. Thomas Kelly was chosen to fill the vacancy at the regular election held on November 8, 1892.

In their preliminary report of January 10, 1891, Engineers Newton and Worthen offered only two routes for comparison. The one which they recommended provided for carrying off the storm water of the upper Desplaines

without the necessity of constructing expensive cut-offs to the lake north of Chicago. The channels designed for the maximum flow of 600,000 cubic feet per minute would suffice for this purpose, and with a gate cut-off in the Ogden ditch line somewhere in the West fork of the South branch it would prevent the high waters of the Desplaines from flowing back into the Chicago river. They estimated the total cost of a channel eighteen feet deep by way of the Ogden ditch at \$25,700,000. If the excavation in earth were reduced to fourteen feet the cost would be \$22,700,000.

In their second report, dated February 21, 1891, the engineers presented the results of a study for the prolongation of the waterway below Joliet "with the conditions imposed of avoiding flooding the upper Joliet basin and drowning out locks 5 and 6, and of securing at the same time more fall for the incidental water power created." Some of these results could be secured, they said, by the construction of a tunnel channel under Joliet, or by laying a wrought iron pipe twenty-four feet in diameter along the banks of the river to a desirable locality below the city of Joliet. Surveys had demonstrated that either a tunnel or an iron pipe extension was entirely practicable. If the flow through the channel were 300,000 cubic feet per minute, with the net fall of some forty-six feet, the power obtained would equal 20,000 net horse power. The cost would be small in comparison with the value of the results.

The engineers were still of the opinion that the drainage channel beyond the Summit should be used as the diversion of the upper Desplaines.

It seemed imperative to the engineers that all the drainage of the Stock Yards and packing houses should be kept out of the east and west arms of the South fork, otherwise the introduction into those arms of fresh water from the lake sufficient to prevent stagnation would be greater in quantity than could be removed by the Illinois and Michi-

gan canal. It was recommended that an intercepting sewer be constructed from Halsted street along the northerly line of the packing houses of a capacity equal to the maximum flow (38 cubic feet per second) of those establishments and extended to the extremity of the west arm. At that point there should be erected a pumping station with a capacity of 700 cubic feet per second, drawing both from the west arm and the intercepting sewer, the contents to be discharged into a sewer or open cut leading through Thirty-ninth street to the Illinois and Michigan canal. The expense of this work should be borne by the private establishments contributing to the nuisance in the South fork and by the city.

As an auxiliary to the drainage system the engineers recommended that the bottom of the canal be lowered about $5\frac{1}{2}$ feet as far as the first lock to aid in the transport of the sewage discharged into it by gravity. The cost would be \$3,200,000. Retaining the pumps at Bridgeport and increasing the flow in the canal by the amount of their capacity with less excavation the cost would be \$1,800,000.

It was recommended that new pumps of larger capacity be substituted for those at the Fullerton avenue conduit and removed to Bowmanville. The reason given was that the North branch, as the area of dwellings extended northward, was progressively the receptacle of sewage, and it would become more and more necessary to shift the pumping and flushing station northward. The communication with the lake at Bowmanville to supply water for flushing might preferably be by a conduit rather than by a cut. A sixteen-foot conduit with suitable pumping engine would cost \$970,000.

The engineers stated that a revised estimate of the excavation of the principal drainage channel would be made as soon as all the measurements were completed. These estimates were never presented, as both Chief Engineer Worthen

and Consulting Engineer Newton resigned their positions on April 21.

The Board adopted an ordinance on April 4 establishing a route for the main channel in accordance with the recommendation of Engineers Worthen and Newton, but took no steps toward its execution beyond directing Acting Chief Engineer Edgar Williams to submit working estimates of quantities and kinds of material to be excavated between the Chicago river and Summit.

The Board was prolific of resolutions at this time, and passed them with little regard for engineering possibilities. On April 21, the day when the resignations of Engineers Worthen and Newton were received, it ordained "that the Sanitary District of Chicago do forthwith enter upon, use, widen, deepen and improve the Chicago river from its mouth at Lake Michigan to the South branch thereof, and also the South branch thereof, together with the South and West forks thereof, so as to make the same a proper and sufficient supply channel for the main channel heretofore surveyed from the Chicago river to Joliet." A copy of the resolution was ordered sent to the Mayor and City Council of Chicago, and the secretary of war of the United States.

Samuel G. Artingstall was elected chief engineer on May 9, and on May 23 presented a report on four "feasible" routes for the main channel between Bridgeport and Summit. The first of these began in the West fork of the South branch at Western avenue, and followed the line of the Ogden ditch to Summit; estimated cost, \$2,108,791. The second began at the junction of the Illinois and Michigan canal and the South fork of the Chicago river, and followed the line of the canal to Summit; cost, \$3,367,313. The third began at the end of the West arm of the South fork near Western avenue, and ran westward along Thirty-ninth street to the Illinois and Michigan canal and westerly along the canal to Summit; cost, \$2,689,872. The fourth followed

the preceding route to the canal, which it crossed, and continued in a northwesterly direction to the Ogden ditch, and along this ditch to Summit; cost, \$2,227,392. The estimates were for channels fourteen feet deep, and with a capacity of 300,000 cubic feet a minute.

On June 20 Mr. Artingstall presented a report covering the route between Summit and Lockport. In some places the route occupied the bed of the Desplaines river, although the channel would be generally artificial. It was subject to the Desplaines river floods, but these would be under control by the use of a movable dam at Lockport. The cost of a channel fourteen feet deep would be \$14,545,465. The cost of right of way was not included in this estimate.

The Board repealed the ordinance of April 4 locating the main channel between Bridgeport and Summit on August 5, and adopted another, locating the channel along the line of the third route suggested by Chief Engineer Artingstall on May 23. On September 16 the Artingstall route between Summit and Lockport was adopted. No further action was taken.

To meet the expenses of the Sanitary District pending the collection of taxes, \$100,000 was borrowed of the city banks. The total expenditures of the district to November 28, 1891, the end of the second fiscal year, were \$669,336.30. Nothing had been accomplished.

CHAPTER XXX.

DEFINITE PLANS AND PREPARATIONS.

Progress dates from the organization of the second Board on December 8, 1891. By the resignation of three Trustees, and the election of Messrs. Boldenweck, Cooley and Eckhart to fill the vacancies, a working majority was obtained. The wishes of the people were no longer disregarded.

Trustee Wenter was elected president of the new Board. In his inaugural message, delivered on December 12, he outlined the new policy. The provisions of the law were well understood by the Trustees, he said, and the will of the people had been thrice expressed in public vote in terms which could not leave any doubt as to the imperative nature of their demands. The necessity for an early completion of the work entrusted to the charge of the Trustees was becoming more pressing by the rapid growth of the city.

"In view of such circumstances," said the president, "it becomes apparent that the dimensions and scope of the channel prescribed by the law cannot be safely diminished, and the Legislature wisely refused to accept a proposed amendment contemplating such a change. While the sanitary requirements of the District make the building of this channel a pressing necessity for the health of our people, the future growth of Chicago depends in a large measure on the carrying out of the law enacted by the Legislature and endorsed by the citizens and taxpayers of Chicago."

With the firm conviction and determination that work must be actually commenced without the least unnecessary

delay, the president recommended that the right of way at the lower end of the channel, which would run through rock, be secured at once. It was evident, he said, that this portion of the channel would require the longer time for construction and should be commenced first. There need be no financial embarrassments since the cash in the treasury amounted to \$728,929.11. This would be increased to more than \$1,000,000 by tax collections before the following July. Zeal and energy on the part of the committees and harmony in the proceedings of the Board were solicited.

President Wenter selected as his lieutenants the following Trustees who were made chairmen of the respective committees: Engineering, Trustee Cooley; finance, Trustee Eckhart; judiciary, Trustee Boldenweck; and federal relations, Trustee Gilmore.

On December 12, the date of the president's message and the selection of the committees, the engineering committee was instructed to examine the work of the engineering department and make such recommendations as would expedite the inauguration of work on the main channel. The committee reported on January 9, 1892, and made these recommendations:

1. Reconsider the route from Sag to Lockport at once and prepare plans for protecting the route from surface water with a view to beginning work on that section at the earliest practicable date. It should be possible to adopt a new route and prepare plans for the route within sixty or ninety days. Sufficient property for right of way could be secured by that time.

2. Re-locate the route where necessary between Willow Springs and Sag with a view to beginning work the ensuing season. This might be accomplished within sixty to ninety days after the proposed plans for the work on the Sag-Lockport section had been completed.

3. Reconsider the entire question of route from Chicago

to Willow Springs in the light of present needs and the requirements of future development. Provision for actual construction on this section should be made not later than the latter part of 1893.

4. Reconsider the route and the treatment of the problem below Lockport. Litigation here might occupy one year, but work need not begin until early in 1895. Meantime the plans might be matured in harmony with some plan for navigation with federal coöperation.

5. Fix the conditions to be met in the Chicago river as soon as practicable so that all structures and modifications in dock lines might conform to a general plan.

To correct some current misconceptions the committee added the following, bearing upon the drainage project as a whole :

“This solution of the sanitary problem was adopted because it was much the cheapest, involved little or nothing for maintenance and operation, and had collateral advantages as a waterway.

“The capacity was fixed by two considerations : That the channel should provide the necessary dilution to maintain a sanitary condition for the probable growth of population during the time for which the bonds are issued, or until the work is paid for ; and that it should be adequate, in conjunction with other works, to remove snow and rain water in floods and thus prevent contamination of the lake at such times.

“It is not practicable on account of excessive cost to make a channel that will carry the requisite volume of water and at the same time be unnavigable. This is determined by the physical conditions. A channel flowing at a high velocity requires a high grade, thus increasing the depth of rock cutting at the lower end. Such a channel will be unstable in the clay.

“For the required capacity a deep channel is less costly

than a wide one. It is also subject to less variation in flow by changes in the level of the lake, by floods and by ice, and it is more easily regulated at the lower end on account of less fall.

"These are the substantial considerations which determined the present general plan as outlined in the law. Fortunately all these conditions are also in the interest of navigation. The only incident for actual navigation is proper railway and highway crossings.

"This law was matured after long consideration and is explicit in its provisions. It lays down the conditions which must be met, and definitely prescribes the limitations upon capacity and size of channel. It is no part of the duty of this Board to question these provisions, and it has no option other than to carry them out in accordance with their full spirit."

Chief Engineer Artingstall resigned his position on January 16, and Benezette Williams was elected to succeed him. The salary of the office was increased to \$9,000 per annum. The chief engineer was at once instructed to submit as soon as practicable alternative plans for the location of the main channel between Sag and Lockport with estimates in sufficient detail to determine the comparative cost of the several lines.

Chief Engineer Williams submitted a report on February 17. Three distinct routes were considered from Willow Springs to Lockport and four from a point above Lemont to Lockport. At or about Lockport all four lines merged into one. A fifth line suggested merely a different method of treatment.

Line No. 1 followed the location made by Chief Engineer Worthen to a point above Lockport where there was a deflection into a line common to all routes. This line was situated almost entirely on the north and west sides of the Desplaines river.

Line No. 2 was the one suggested by Chief Engineer Artingstall, intersecting the common line at Lockport. It followed the bed of the river as closely as was consistent with a satisfactory alignment.

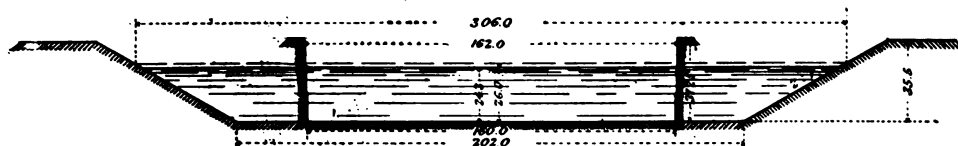
Line No. 3 was a new location throughout. So far, as possible it lay on the south and east side of the Desplaines river, between the river and the Illinois and Michigan canal. It crossed the bends of the river in a few places but in such a manner that with a small amount of excavation the river channel might be so changed as to protect the new work. The line involved a new location of the Chicago, Santa Fe and California railway for a distance of 22,200 feet.

Line No. 4 followed line No. 3 to a point nearly $1\frac{1}{2}$ miles above Lemont where it diverged. It crossed the Illinois and Michigan canal one-half mile below Lemont and again one mile above Lockport. This line involved the shifting of the tracks of the Chicago and Alton railroad for a distance of 4,000 feet.

Line No. 5 started at Willow Springs coincident with line No. 2 and reached dam No. 1 by making only two curves. There were many complications in its construction.

Mr. Williams favored line No. 3, the estimated cost of the construction of which was \$11,740,678. With some modifications this line was adopted by the Drainage Board and proposals were asked for under three propositions, differing chiefly in the manner of disposing of the material excavated. Proposition No. 1 provided for the removal by the Sanitary District of the material taken from the bed of the channel in certain sections to the Joliet end of the channel where an embankment was to be constructed to create a reservoir for water power purposes. Proposition No. 3 provided that the contractor should haul the excavated material from the same sections to the embankment at his own expense. Proposition No. 2 provided for the deposit of the

SANITARY CANAL - CHICAGO



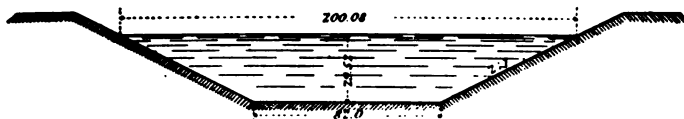
MANCHESTER



NORTH SEA - BALTIC -



NORTH SEA - AMSTERDAM -

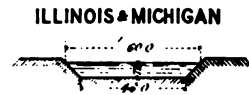
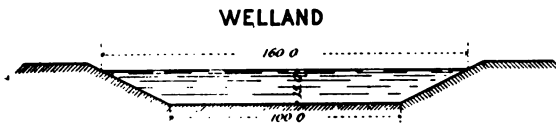
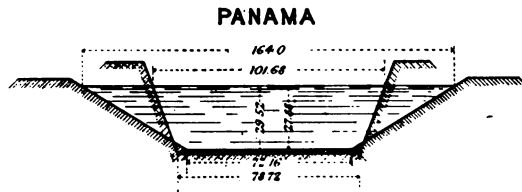
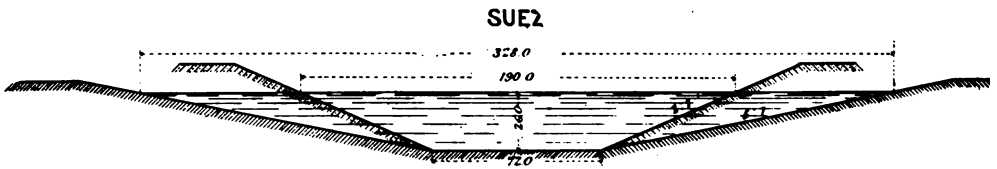


CROSS SECTIONS OF NOTED CHANNELS. (PLATE I.)

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CROSS SECTIONS OF NOTED CHANNELS. (PLATE II.)

1

material along the banks of the channel at the convenience of the contractor.

The work, for which tenders were invited by advertisement dated April 7, 1892, was estimated to consist of the excavation of about 11,500,000 cubic yards of solid rock and about 5,000,000 cubic yards of earth, and the building of about 287,241 cubic yards of dry rubble walls and 244,444 square yards of slope paving. The line was divided into fourteen sections, each about one mile in length. Each section was to be treated as a separate contract.

Bids were opened on June 8. There were twenty-six bidders. The total of the lowest bids under proposition No. 1, was \$10,111,731.87; under No. 2, \$10,696,754.98, and under No. 3, \$17,105,935.83. Although the bids under proposition No. 1 appeared to be the lowest they were not, since the Sanitary District would still incur the expense of hauling the spoil an average distance of ten miles to build the levee near Joliet. The Board decided to accept the lowest bids under proposition No. 2, and contracts were awarded, the first on July 13. The table below gives the price per cubic yard for earth and rock excavation respectively and the total of each contract as determined from the estimated amount of excavation:

Sec.	Contractor.	Price in Earth.	Price in Rock.	Total.
1.	Arthur Harlev	.27	.83 $\frac{1}{2}$	\$754,325 97
2.	McArthur Brothers	.28	.91	646,968 50
3.	" "	.27	.86	732,024 44
4.	" "	.27	.86	729,841 72
5.	Agnew & Co.	.27	.73 $\frac{1}{2}$	522,141 48
6.	" "	.27	.73 $\frac{1}{2}$	602,487 81
7.	" "	.26	.73 $\frac{1}{2}$	622,791 08
8.	" "	.26	.74 $\frac{3}{4}$	896,269 17
9.	" "	.26	.76 $\frac{1}{10}$	996,574 82
10.	E. D. Smith & Co.	.25	.80	1,002,745 15
11.	Mason, Hoge & Co.	.30 $\frac{1}{4}$	.79 $\frac{1}{4}$	820,434 97
12.	" " "	.30 $\frac{1}{4}$	.79 $\frac{1}{4}$	812,756 82
13.	" " "	.27 $\frac{1}{2}$	.75 $\frac{1}{2}$	775,817 89
14.	McCormick Constret'n Co.	.20	.73	788,298 64
Total,				\$10,696,754 98

Each contractor was required to give a satisfactory bond in the sum of \$100,000 covering each section, the work to be completed on or before April 30, 1896.

On February 17, 1892, the chief engineer was directed to make comparative estimates on three alternate routes between Ashland avenue and Willow Springs, one of the routes to follow the Illinois and Michigan canal. A report under this order was presented to the Board on June 7. It covered five routes,—Ogden Ditch line, No. 1 ; Ogden Ditch line, No. 2 ; Canal line ; South Fork and Ogden Ditch line ; South Fork and Canal line, and South Fork line. The cost of each of the Ogden Ditch routes was estimated to be \$830,000 and that of the canal route \$923,000 ; the others were considerably higher. Mr. Williams preferred the canal route for the following reasons : On a like basis as to right of way it was shown to be \$1,058,901 cheaper than the next cheapest route, and by sacrificing certain prospective advantages in dockage it could be made still cheaper. Work could be begun on it immediately. It was subject to less objection from a railroad standpoint than any other route. Should supplemental works to supply water to the main channel be carried out it was located in the best position to command the situation.

The Board adopted the canal route, but afterward abandoned it because of unexpected complications with railroads and the canal commissioners.

George W. Smith was elected attorney of the Board of Trustees on July 20, 1890, but surrendered the office on April 25, 1891. He was succeeded by Adams A. Goodrich on June 13, 1891, who resigned on February 24, 1892. Orrin N. Carter was elected to succeed Mr. Goodrich on the date of the latter's resignation.

Austin J. Doyle resigned the office of clerk on July 1, 1890. He was succeeded by Thomas F. Judge on July 12, 1890.

Chief Engineer Williams tendered his resignation on June 7, 1893, and was succeeded by Isham Randolph on the same date.

Charles Bary, secretary, resigned on December 31, 1890. The office of secretary was afterward abolished.

The following statement gives the names of the Trustees and chief officers of the Sanitary District since its organization and their term of office:

Name.	Office.	Term of Office.	
Murry Nelson	President	Feb. 1, 1890 to	Dec. 2, 1890
Richard Prendergast	"	Dec. 2, 1890	" Dec. 8, 1891
Frank Wenter	"	Dec. 8, 1891	"
John J. Altpeter	Trustee	Dec. 12, 1889	"
A. P. Gilmore	"	"	"
Christopher Hotz	"	"	" Jan. 16, 1892
John A. King	"	"	" July 22, 1891
Murry Nelson	"	"	" June 19, 1891
Richard Prendergast	"	"	"
W. H. Russell	"	"	"
Frank Wenter	"	"	"
H. J. Willing	"	"	"
William Boldenweck	"	Nov. 3, 1891	"
Lyman E. Cooley	"	"	"
Bernard A. Eckhart	"	"	"
Thomas Kelly	"	Nov. 8, 1892	"
Lyman E. Cooley	Chief Engineer	Feb. 1, 1890	" Dec. 10, 1890
W. E. Worthen	"	Dec. 17, 1890	" April 21, 1891
S. G. Artingstall	"	May 9, 1891	" Jan. 16, 1892
Benezette Williams	"	Jan. 16, 1892	" June 7, 1893
Isham Randolph	"	June 7, 1893	"
John Newton	Consulting Eng.	Dec. 10, 1890	" April 21, 1891
S. S. Gregory	Attorney	Feb. 1, 1890	" June 26, 1890
George W. Smith	"	July 20, 1890	" April 25, 1891
Adams A. Goodrich	"	June 13, 1891	" Feb. 24, 1892
Orrin N. Carter	"	Feb. 24, 1892	"
Austin J. Doyle	Clerk	Feb. 1, 1890	" July 1, 1890
Thomas F. Judge	"	July 12, 1890	"
Byron L. Smith	Treasurer	Feb. 1, 1890	" Jan. 23, 1892
Melville E. Stone	"	Jan. 23, 1892	"
Charles Bary	Secretary	Feb. 1, 1890	" Dec. 31, 1890
William Martin, M.D.	Sanitary Insp'r	Nov. 30, 1892	"
U. W. Weston	Supt. of Const.	June 14, 1893	"
Edward Williams	Marshal	July 5, 1893	"

The salary of chief engineer, originally \$6,000, was advanced to \$9,000 when Mr. Williams was elected to the office. The salary of the clerk was made \$6,000 when the Board organized, but it was afterward reduced to \$4,000. When Mr. Stone became treasurer he declined to receive any salary.

CHAPTER XXXI.

INAUGURATION OF THE WORK.

Work on the main drainage channel was inaugurated by formal ceremonies on September 3, 1892. A special train running over the Santa Fe railroad carried about five hundred guests from Chicago to the boundary line between Cook and Will counties, thirty-one miles from Chicago and two miles west of Lemont. A platform had been erected over the center line of the channel and the first earth was lifted from the two counties.

Among those present were : President Frank Wenter, and Trustees John J. Altpeter, William Boldenweck, Lyman E. Cooley, Bernard A. Eckhart, Arnold P. Gilmore, Richard Prendergast, William H. Russell, Chief Engineer Benezette Williams, Attorney Orrin N. Carter and Clerk Thomas F. Judge, of the Drainage Board ; ex-Drainage Trustee John A. King, ex-United States Senators Charles B. Farwell and James R. Doolittle, ex-Mayors Carter H. Harrison and DeWitt C. Cregier, Commissioner of Public Works J. Frank Aldrich, ex-Chief Engineer of the Drainage Board Samuel G. Artingstall, ex-Secretary of the State Board of Health John H. Rauch, Corporation Counsel John S. Miller, Commissioner of Health John D. Ware, Senator Thomas C. MacMillan, ex-Congressman George E. Adams, Captain James S. Dunham, T. T. Johnston, Ossian Guthrie, Joseph Donnersberger, Louis Hutt, Julius Goldzier and Fernando Jones of Chicago ; Mayor P. C. Haley, J. L. O'Donnell, ex-Mayor J. D. Paige and ex-Senator Thomas H. Riley of Joliet ; Congressman Thomas Henderson of

Princeton ; George Brenning of Centralia ; H. M. Dunlap of Champaign ; E. B. Matthiessen and James T. Tranch of La Salle ; J. H. Alexander, Dr. C. H. Bacon, William Keough, J. M. Leighton, George M. Lynd, O. W. Moon and J. L. Norton of Lockport ; J. F. Sanford and Thomas Cronin of Morris ; Henry Mayo, S. C. Stough and George Brown of Ottawa ; B. L. T. Bourland, R. R. Bourland, O. J. Binley, S. A. Rinney and C. P. King of Peoria ; Joseph Means and Joseph Reinhardt of Peru ; ex-Congressman Ralph Plumb and John C. Ames of Streator.

After an invocation by Bishop Fallows the opening address was delivered by President Wenter. At the conclusion of his address President Wenter stepped down from the platform and raised the first shovelful of earth from its native bed, using a nickel-plated shovel prepared for the occasion. The earth was deposited in a tin box held by Trustee Boldenweck and carried to the offices of the Drainage Board where it was preserved as a memento of the ceremonies.

Trustee Cooley, at the conclusion of his address, which followed that of the President, touched an electric button which fired the first blasts of rock in the bed of the channel. One of these was from a spot five hundred feet west of the platform, and the other, the same distance east of it. Pieces of the disengaged rock were also gathered up as mementos.

The addresses of the day were as follows :

INVOCATION BY BISHOP SAMUEL FALLOWS.

ALMIGHTY GOD, OUR HEAVENLY FATHER, we thank Thee for this bright and beautiful day, and for these auspicious skies which Thou has vouchsafed to us on this eventful occasion. Without Thee nothing is holy, nothing strong. We therefore pray Thy heavenly benediction upon the great work begun here to-day, for the health of our City, and for the welfare of our State and Nation. We pray that wisdom and har-

mony and integrity and efficiency may be given to all those having this work in charge, so that it may speedily and successfully be brought to its conclusion without accident and without delay. And the glory shall be Thine through Jesus Christ, our Lord. *Amen.*

ADDRESS BY PRESIDENT FRANK WENTER.

FELLOW CITIZENS, FRIENDS AND PEOPLE OF THIS VALLEY : To-day, after nine months of energetic work by the present Board as organized, we are ready to order practical operations to begin, and we are here to put the shovel in the ground as a token of activity; as a sign to thousands of toilers that employment can be had; as a notice to the people of the Illinois valley that the agreement, ratified by the State, is to be carried out in good faith; as a notice to the country at large that Chicago, through the Sanitary District, proceeds to construct a mighty channel which will rank with the most stupendous works of modern times.

The beginning of this work marks a new era in the history of Chicago. When once finished Chicago will be the healthiest city on the continent,—happily situated on a chain of lakes inexhaustible in their waters, pure and sweet. On the west, north and south for a thousand miles and more we find the most fertile soil that man ever tilled. Ask me an empire and I will name you the Mississippi valley. Which is the chief city in that valley? Has nature not endowed her with all the advantages?

The waters on the west within ten miles of her main arteries find their way through the Desplaines and Illinois rivers to the Mississippi. What prevents the blue waters of Lake Michigan from flowing in the same direction? A little ridge called Summit forms the divide, about twelve feet above the level of the lake. This divide we propose to cut through and send the waters of Lake Michigan southward, thereby solving her sanitary problem for all time, and insure her future growth and prosperity. (Applause.)

The importance of the work cannot be over-estimated, either from a sanitary or a commercial standpoint. The commercial value of the channel to be constructed is very far-reaching. While the work now planned will not complete a continuous waterway, yet it will only require another link to weld the chain complete and make Chicago the commanding city over river commerce as well as lake.

The well known query, "When will the big ditch begin?" is a thing of the past. That query was undoubtedly ringing in the ears of those Trustees that took an interest in the progress of the work, and it certainly reminded us constantly of our duties to the city of Chicago,—to begin actual construction. For the past nine months every department of the Sanitary District, from the engineering to the legal, has pushed its work with all the energy that men possess. Credit is especially due the chief engineer and the attorney of the Board. All this was made possible by the prompt and wise action of the committees on engineering, finance and judiciary, the members of which have sacrificed their personal interest in public behalf.

The present Board was organized December 8, 1891. From that time to date every effort has been made to gain and maintain the confidence of the people. The departments were reorganized with responsible men at the head, with the understanding that their time and services be exclusively given to the Sanitary District. (Applause.)

The engineering committee has been in almost constant session in maturing plans and giving proper direction to the work.

Many difficulties presented themselves from time to time as we progressed with the work, but they were overcome, so that on March 30, 1892, the right of way ordinance and specifications for contracts were adopted, and on June 8 the bids were received and opened. The Trustees were gratified to find that the prices were close to the estimates. The pessimistic predictions as to the cost were silenced as the bids demonstrated that the cost of the channel was entirely within the financial resources of the District. (Applause.)

On June 29 contracts were awarded covering a distance of fourteen miles from Willow Springs to Lockport, for the sum

of \$10,696,754.98. In the meantime the legal department, aided by the finance and engineering committee, has secured through condemnation and purchase at reasonable prices, about 2,600 acres of land, or about eighty per cent of the right of way required.

From Willow Springs to Summit for a distance of six miles, the Board has advertised for bids to be opened October 19. From Summit to Ashland avenue the Illinois and Michigan canal is recommended for adoption. The contracts awarded stipulate that the channel shall be ready by April 30, 1896, and every other contract to be awarded will be made to conform to that time.

A great deal of criticism was heaped on the Board for building the channel of the required size as prescribed by law, yet if such size was not mandatory it would be more than shortsighted to build it of less capacity than contracted for. The size of the channel is to be 160 feet wide through the rock with a depth of 18 feet, and the same width or more through the clay with a depth to carry 14 feet of water, provided the population is not over 1,500,000; when beyond that the law requires an enlargement of the channel through the clay.

The present canal as used for sanitary purposes is 60 feet wide, with a depth of from 8 to 10 feet. The carrying capacity is from 60,000 to 80,000 cubic feet a minute, or about large enough to answer the sanitary requirements of a city of 300,000 people. Assuming there was no law on the question as to the size of the channel, would it be wise, would it be prudent, would there be any foresight in constructing a channel that might possibly answer the requirements of a city of 1,500,000? What is the population of Chicago to-day? It is certainly over 1,400,000. What would any sensible man do in these premises? If he has no faith in Chicago's future growth then a channel of 300,000 cubic feet will answer, but if he believes the city will have 2,000,000 in the very near future; yes, and another 1,000,000 to follow, what will he do, what shall he do, to provide for the future? I say yes, build the large channel.

We to-day, as Trustees of the Sanitary District of Chicago, in the presence of many of the officials of city, county, state and

the United States, many of its citizens and representatives from the Illinois valley, have assembled on the line of Will and Cook counties, in the valley of the Desplaines, to officially inaugurate this great work connecting Lake Michigan with the Mississippi, to create a condition that undoubtedly in ages gone by existed, to tap the great reservoirs above that will swell and stimulate the sluggish stream of the Illinois and with proper assistance make it the great waterway from the lakes to the Gulf of Mexico. (Applause.)

ADDRESS BY TRUSTEE LYMAN E. COOLEY.

MR. PRESIDENT, LADIES AND GENTLEMEN :— We stand here to-day on the rock rib of the continent, 585 feet above ocean tide, at the summit of the trough, falling southward 1,600 miles to the Gulf of Mexico, dropping northeasterly 1,800 miles into the Gulf of St. Lawrence; in the continental groove, down which through alluvial plains glide the waters of the Mississippi system to meet the tropic sun, in which are gathered the Great Lakes to fall tumultuously to the rock bound winter shores. (Applause.)

We stand here on the divide, between these bordering hills of the Desplaines valley, on the floor of the ancient outlet over which but yesterday, in time, flowed the waters of the lake plateau twenty and more feet in depth. Five feet above the Michigan-Huron Lake, the water would spill here in storms but for the little alluvial barrier at Summit. Nine hundred miles away, at Black Rock, the modern outlet leads to the Niagara, its floor but thirty feet lower than the rock on which we stand.

We may well marvel at the narrow margin, the strangemischance, which favored the forbidding St. Lawrence Gulf with the lake outflow, and inquire of nature why we lost our heritage, why she tilted the lake plateau, shifted the outlet and bared the floor of this old pass. We are here by right of primogeniture to claim all that which we should possess and have the energy and purpose to acquire. (Applause.)

The lake outflow added nothing to the St. Lawrence Valley,

for the needs of commerce in that direction could have been better solved without it. Had it continued southward, the biggest ships that float could have come through the most productive core of the Mississippi Valley to within sixty miles of this spot, and by works obvious to the first generations of men, ascended the 140 feet lying below us and swept the resourceful limits of the lakes. Think of it ! The Great Lakes crowning the Mississippi Valley, the sea coast extended 2,500 miles into the continental heart, gathering the arteries of commerce from Rocky to Appalachian summits and from Gulf to frigid zones. How different would have been settlement, growth and history, what Chicago might have been from what she is.

Man's creative intelligence can remedy nature's caprice, restore the ancient outlet ; and even more, extend through the continent from fog bank to tropic breeze as though it were the sea, joining coast, lake and river systems in one whole as is not possible elsewhere on earth. Then, indeed, may we go down to the sea in ships. (Applause.)

More legible than Nineven tablet and Egyptian monument is the record of what nature has wrought, eloquent hieroglyphs in moulded hill and vale and carved rock, inspiring man's conception and teaching work in harmony with her methods, dictating that policy which makes what we now achieve but a progressive step to all the needs of the future, so that the dreams of to-day, however slowly, may surely crystallize in the realities of to-morrow.

Northeast, twenty-seven miles, are the blue waters of Lake Michigan, and margined along its shores for twenty miles, and but eighteen miles away, is the crown of our great State, the summit city of the continental valley. In the last decade, its population doubled, and with 1,400,000 people to-day, good health and adequate facilities for commerce will make 3,000,000 in the next fifteen years. (Applause.)

That fair city has attracted a virile, hustling, adult population who should show a cleaner bill of health than any other ; but unnecessary disease and sickness and death prevail, losses that to cold financial calculation mean the interest on a hundred

million dollars, losses that to human kind mere money cannot measure.

Lead the blue waters in cleansing rivers through that city, gather them in the main outlet where we stand to-day, in volume beyond offense to any citizen, and even to the fish that swim therein,—that is the mission of the Sanitary District.

Nine miles to the south and west, and forty-five feet below us, is Joliet, dropping in the next four miles to eighty feet. We are across the Chicago divide and in the beautiful valley, descending by rapids and pools sixty-five feet in fifty-five miles to Utica; thence, through alluvial savannahs for 227 miles to the Mississippi, 170 feet below our lake and 295 miles from where we stand.

Towns and cities nestling in the valley are strung like beads along the river course, and to them this great stream bears commerce as its only token of promise, such commerce as other improvements and projects but vex in spirit.

On the one hand, we have twenty-seven miles to the waters of Lake Michigan, actuated by a sanitary purpose; on the other, 295 miles to the Mississippi, looking to commercial ends; and yet the commerce which the valley seeks is doubly valuable to our city, and the waters which lave Chicago perform an equal service for her towns and cities; and in the wake of these benefits are water power and lands reclaimed, added resources to the wealth of the State. (Applause.)

The law has wisely decreed that health and commerce shall go hand in hand, and that this channel shall be so fashioned. To-day, on the line that divides the County of Cook from the State at large, that has hitherto marked the diverse interests of metropolis and valley, and by these tokens, we betroth these separate purposes, to be hereafter as one. (Applause.)

The work this day begun is to cover the Chicago divide, forty miles from Lake Michigan to Lake Joliet, with over thirty miles of channel complete for navigation. The cost will be greater than to extend fourteen feet for 280 miles farther to the Mississippi.

The volume of water will give steamboat navigation in the lower river without obstructing locks and dams, in which nature,

assisted by art, may develop increased depths. Permanent works are required for the gap of fifty-five miles between Joliet and Utica, but this problem is simpler than that of the Chicago Divide.

The policy underlying the law is an open river below Utica, to be improved progressively in conjunction with a water supply from Lake Michigan; works above Utica so designed as to permit future increase of capacity, and such a plan for the Chicago Divide as will facilitate enlargement to any requirement of water supply from the lakes to the Mississippi,—the entire work to be carried out through the coöperation of City, State and Nation.

The augmented volume southward will inspire the call from here to the Gulf for all the lakes can spare. The lake region and the Mississippi Valley will join in the largest useful development. And so the sanitary needs of that future, which no man can now foresee, will surely become the incident of a commercial purpose that enlists the nation.

This is the logic of our policy. To-day we cut the Chicago Divide for an urgent sanitary need which rouses our city; and in so doing we sever the gordian knot which has fettered all projects, loosen possibilities of which statesmen have dreamed for a century, and, in the manner of our doing, we set the gauge which shall govern the waterway of a continent. (Applause.)

He who set his conception as the limit of human achievement writes in his designs the obituary of his enterprises. This City, this State, this Nation, are but in youth, and we can only dream of what they may seek to do in manhood and maturity. We do well if we work in the line of a continuing policy and construct no barriers.

From the St. Lawrence to the Mississippi, Joliet the soldier, La Salle the chevalier, Hennepin the priest, followed the trail of the waters and traversed this portage two centuries ago (1670-80). On Sag hill, yonder by the little church where the routes from Chicago and Calumet converge in this throat, the strategic point for commerce and defense, was established the first post in this region. The logic of the waters determines a metropolis, and mantled with the spirit of these explorers we

to-day cut the portage and trail the lakes past cities named for them. (Applause.)

The first canal project is credited to Joliet. Be that as it may, in 1808, Albert Gallatin, secretary of the treasury, makes official recommendation in his report on means of internal communication. Examinations and surveys follow, and from 1822-36 various acts of State and Federal legislation. Beginning in 1836, the present canal was opened in 1848, and the summit level cut down to the lake, as you now find it, in 1866-71.

In 1826 Clinton came to urge this link in a navigable circuit from New York to New Orleans, and Dearborn wrote in 1838 of a proposed ship canal not less than ten feet deep.

In 1858 John B. Preston proposed a steamboat canal six to eight feet deep and 160 feet wide, and in 1862 it was urged in Congress as a war measure. Army officers have reported the project favorably several times since and two locks and dams have been built by the State, a third by the United States and a fourth is in progress, an expenditure of about six per cent of the total estimate to Lake Michigan. This is the result of thirty-four years of agitation and official recommendation and for a project that was superannuated twenty years ago.

Seven years and seven days have come and gone since this enterprise was first urged upon our people, and through many vicissitudes it has reached the present stage, accepted as the only sanitary solution, recognized as of commercial importance to the State and its chief city and as of national concern.

As long as Jacob labored for Rachel have some of us labored for this day, and will yet labor for full seven years more for the further purpose that health and commerce and all affiliated benefits may associate in one great whole. (Applause.)

North to the frozen zone, east to the Alleghanies, south to the Gulf, west to the Rockies,—an imperial domain of resources in forest, field and mine, as yet but scarcely opened,—the population this may sustain, the civilization that may mature, is beyond prophetic ken. Point out the areas of richest soil, where food will be most abundant, and there ultimately will it be densest. Find the spot where the commerce of this people

may be most cheaply handled, to which food, raw material and power shall most readily assemble, and from which manufactures may be best distributed, and there will be the chief city.

No accident placed the urban population of the United States on navigable waters, determined wealth along their shores and located the most valuable railway properties in competition therewith.

Look at the position of Illinois in respect to these resources, in respect to transportation by rail and water and in respect to climate,—is she not to be the central ganglion of a marvelous growth? Look at her chief city; where is site more favored? Provide for health, develop the facilities which nature invites, follow a policy as though our estates were vested in one man and that man's life prolonged through the generations, and we rise to the level of our opportunities.

What we do to-day is but the beginning. An object vital in itself is to be attained as soon as practicable; yet, in achieving it, we but unfold larger purposes, purposes that in their consummation are but added resources, developing our estate to fuller fruitfulness by works that involve no tax for operation, maintenance and renewals, carvings on the bosom of mother earth that will persist in usefulness until nature in her cycles renews the face of continents.

Machines will vanish in rust, the proudest monuments of man will sink to rubbish heaps, and his greatest works trail in curious mounds, while this goes on as nature's self, an added feature to mother earth as though it had always been. (Applause.)

ADDRESS BY TRUSTEE BERNARD A. ECKHART.

MR. PRESIDENT, LADIES AND GENTLEMEN :—We are assisting to-day in the inauguration of a work of vital importance to the people of Chicago and the adjoining country. It is a work necessary alike to the sanitary well-being and the commercial interests of the one and a quarter millions of inhabitants of this city. I have heard, I am sorry to say, a few well meaning persons express surprise that an enterprise of such magni-

tude should be undertaken; rather should the wonder be that we were not forced to do something of this kind years ago. No other civilized community would be guilty of such prolonged and continuous contamination of its water supply. Blessed, as few cities are, with an unlimited reservoir of pure water at our very doors, we have deliberately gone on year after year pouring into it a stream of filth from our sewers.

In many countries the pollution of the water supply is considered an offense of great magnitude and those guilty of it receive severe punishment. But here in Chicago we have been too busy to give proper attention to a matter even of such grave importance as this until the consequences of further neglect began to be forced upon us in a very embarrassing and disagreeable way. However neglectful the people of the West may be while in a state of fancied security, they have fortunately a business-like manner of grappling with an evil when once fully aroused to the necessity for its extinction, and it is the exercise of this spirit which has made possible the undertaking of such a vast work as that begun here to-day.

I am sure that you, Mr. President, and the other members of the Board of Trustees, will pardon me for the use of an expression borrowed from so distinguished a gentleman as Mr. Cleveland. It is a condition, not a theory, which confronts us. The drainage channel of the Sanitary District of Chicago is under way. And, now, my friends of the press, to this extent, at least, is the excuse for a continuance of your kindly meant, but sometimes stinging jokes withdrawn. The preparatory work on an enterprise of this magnitude, cannot be done in a day, nor a week, nor a month. Our President has ably told you in detail of the labors of the Board of Trustees since the organization of the Sanitary District and outlined that to be done in the future. The engineering difficulties and possibilities of the immense work have been clearly set forth by the expert chairman of the engineering committee. From the statements of these gentlemen you can learn all that any one could possibly desire to know regarding the size, scope, direction and use of the drainage channel and the probable length of time required for its construction.

What more could one want? Ah, yes; the cost. Well, that's what I'm here for. This part of the programme is assigned to me. The item of cost in an enterprise of this kind is a consideration, it is true, but it is results we are after, and we have got to have them. The expense of digging the main channel, with the acquirement of the right-of-way and the payment of railway damages, is estimated at \$22,000,000. An immense sum of money, some of you will say; another call for oppressive taxation and all that sort of thing. Well, let's see about that. This work is being done under a legislative enactment of 1889, which created the Sanitary District of Chicago, and gave the right, under certain proper limitations and restrictions to cut a channel through the "Divide" so that the sewage of Chicago can be discharged into the Illinois and Mississippi rivers. This Act also provides for the issue of \$15,000,000 of twenty-year bonds, and the levying of a tax of not over one-half of 1 per cent per annum on the assessable property in the district, with the further provision that special assessments may be levied on property especially benefited by the work. Now bear in mind that this tax of one-half of 1 per cent a year is to pay all the cost of making the channel,—salaries, office expenses, construction expenses and principal and interest of the bonds. The bonds will be issued and sold for the purpose of getting money with which to push the work to completion in four years, but the taxpayers will only pay them off at the rate of one-half of 1 per cent a year. Terrible taxation, this. Awful, isn't it? Gentlemen, how many of you know that you have been paying this Sanitary District tax for two years? Why it is only a few days ago that one of the largest taxpayers in Chicago asked me when we would levy the drainage tax. (Laughter.) He had paid his own one-half of 1 per cent on a large amount of property and he didn't know it. This shows better than any argument that I can make how easy it will be to pay for the work. (Applause.)

Our resources for the next four years will be as follows:

RESOURCES :

Balance on hand June 14, 1892.....	\$1,000,000
Taxes 1891 (valuation \$254,000,000), balance in process of collection.....	650,000
Taxes 1892 (valuation \$260,000,000), estimated.....	\$1,300,000
Taxes 1893 (valuation \$275,000,000), estimated.....	1,375,000
Taxes 1894 (valuation \$290,000,000), estimated.....	1,450,000
Taxes 1895 (valuation \$305,000,000), estimated.....	1,525,000
Taxes 1896 (valuation \$320,000,000), estimated.....	1,600,000
Special Assessments.....	1,000,000
Bonds, total issue.....	15,000,000
Total resources.....	\$24,900,000

What will we get for this expenditure? First, an unlimited supply of pure water for a city which is growing so fast that the securing of water for household use is a problem the serious features of which increase daily. Second, an outlet for the sewage of one, five, yes, ten millions or more of people at a nominal cost and without danger of contagion or other objectionable phases. Third, navigable waters between the lakes and the Mississippi river, with the coöperation of the General Government, thus opening to commerce a new and cheap route between Chicago and the Gulf of Mexico, via New Orleans. (Applause.)

The advantages of such a waterway will not be for Chicago alone; every part of the great State of Illinois, every section of the entire northwest will be benefited by it. So highly are waterways of this kind esteemed in other communities that hundreds of millions of dollars have been expended for the construction of commercial canals which were not intended for and are not used for purposes of drainage, as is the main object in the work which we have so auspiciously inaugurated to-day.

The State of New York alone has spent over \$80,000,000 on its commercial canal system, or nearly four times what this main channel with a double use will cost. The Nicaragua canal is estimated to cost \$90,000,000, and that is for the transfer of ships only, but I believe it to be a desirable work even at that immense outlay. In the far-off city of Amsterdam the sturdy Hollanders have expended about \$14,500,000 in digging a canal to the sea, which is at the rate of \$1,000,000 a mile. Rather expensive work that, but the thrifty Dutchman calls it a good

investment. Take the big Manchester ship canal in England. This work was begun in 1887 and six years were allowed for its completion. It is not done yet, nor anywhere near it. What do you think it will cost? Only a mere bagatelle of \$65,000,000.

In discussing a great improvement of this kind the examples set by other cities is always instructive. Experience is a good teacher. Experience has taught the world that no community can continue to increase in population and retain a fair condition of health, unless its water supply and sewerage are good.

People may accustom themselves to living in rude houses, to wearing poor clothes, and to exist on scanty rations, but unless their drinking water is good they will soon sicken and die. One of the surest preventatives of plague is a pure water supply, and this cannot be had so long as the sewage of a town is allowed to drain into it. (Applause.)

London, founded hundreds of years ago, has a population of about four millions. Chicago, founded say sixty years ago, has over one million and a quarter inhabitants. At this rate it will be only a few years before our city is as large as the great metropolis of England.

How do we stand in relation to London in the matter of drainage and water supply? The Metropolitan Board of London was established in 1855 for the purpose of constructing a new sewerage system. It got to work in 1856 and in the thirty-two years ending in 1888 had expended \$35,000,000 in main sewers alone, the small branches being paid for by the parish boards. In London water service has been for many years in the hands of private companies. It is sadly deficient, and an attempt was made by the municipal government not long ago to buy out the plants. These were antiquated and of but little real use, it being the intention of the city authorities to replace them with an improved system. Well, the private companies finally agreed to sell out, but what do you think they asked for their business? It was the modest sum of \$170,000,000. On the advice of eminent engineers the city declined to make the purchase and arranged for the outlay of \$60,000,000 in securing a supply of drinking water from the chalk strata to the amount

of four gallons a day for each inhabitant and an unlimited amount of river water for general use. But even under this arrangement London is badly off, as the drinking water supply is wholly inadequate and the drainage is radically imperfect.

The city of Paris, with its numberless canals, aqueducts, reservoirs, filtrations and other improvements, on which over \$40,000,000 has been expended since 1856, would seem to be well fixed for a city of two and a half million people. But even with this outlay, and an even greater one for sewerage, the needs of the inhabitants are not met.

Within the last two weeks prominent engineers have been asked to prepare plans and estimates for cutting a canal from Paris to the sea, a distance of 111 miles. The cost of such a channel will be enormous, but it is a necessity and the Parisians will pay it cheerfully.

In Manchester, England, there are only 379,800 people, but they have under discussion a project for bringing a limited supply of water from Thirlmere lake, a distance of over 100 miles, at a cost of \$18,000,000.

Liverpool, England, gets a daily supply of thirteen million gallons for 613,463 people at a cost of ten million dollars. The water is conveyed a distance of sixty-eight miles by aqueducts and steel tubes, which pierce several ridges, cross a number of small streams and canals, and run under the rivers Weaver and Mersey and the Manchester ship canal. And even at this great trouble and outlay the supply is very scanty.

The people of Vienna have expended \$10,000,000 in getting water from the mountains, fifty-eight miles away, and their only regret is that they didn't pay more money when they were doing the work and get a larger supply.

For \$9,000,000 the people of Glasgow get a supply of water from Loch Katrine, about thirty-five miles away.

It must be remembered, however, that none of these foreign cities is growing with the rapidity of Chicago, and it is well for them in a way that they are not. Some of their people would have to go thirsty and dirty with their present beggarly supply of water if there were any decided increase in population.

The best comparison probably is with New York. There

the water supply is brought from Croton lake, thirty-two and one-half miles north of the city, by an aqueduct across the Harlem river. This work cost \$37,000,000, but the supply has been so short for years that its enlargement at an additional outlay of \$4,000,000 is contemplated.

The park system of Chicago is very justly a matter of great pride. There are few cities in the world with so many, so extensive and so beautiful pleasure grounds. Go where you will and you will hear flattering comments made on the parks of Chicago. Fifteen or eighteen years ago, I think it was, that this beautiful work of improvement was begun. Park after park has been opened and a connecting system of boulevards constructed at an aggregate cost of something like \$24,000,000, or a little more than we propose to expend in making the main drainage channel. (Applause.)

This is a lot of money to be sure, but did you ever hear a sane person object to the expense of park construction and maintenance? Did you ever know of a taxpayer who could point out where the taxes were appreciably increased by the park assessments? No, indeed. The people of Chicago look upon the money put into these beautiful parks as an investment for the benefit of good health, and the improvement of their physical and moral well being, and so it is. If it were a possible thing do you think the people would surrender their parks to-day on the repayment of the twenty-four millions of dollars they have put into them? It would bankrupt the county of Cook to support its hospitals for the insane if such a thing were even seriously considered. As it is with the parks, so it will be with this drainage channel. Ten years hence and this work will be pointed out as one of incalculable benefit to the people of Chicago and the Northwest. (Applause.)

If there were any legitimate way in which private capital could be enlisted in this work; if it were not against the spirit and letter of the law and contrary to the best interests of the community, ample funds would be forthcoming. But our Legislature has wisely made provision for its construction as a public improvement, and arranged for the payment of the expense in a manner that will not be noticed by the taxpayers,

and which at the same time makes the Sanitary District bonds a gilt-edged investment.

We have good reason to be thankful, my friends, that Chicago is so well situated. Lake Michigan will furnish pure water at small cost to millions upon millions of people. All we have to do is to keep our filthy sewage out of it, and this is what this drainage channel will do; and, taking as a guide the cost of similar improvements in the other cities to which I have referred, we have good reason for self-congratulation. Nature has done much for us in the arrangement of a natural waterway, the only barrier in which is that glacial formation known as the Chicago divide. We have but to pierce through this barrier and we set in motion a strong and constant current flowing southward from Lake Michigan to the Gulf.

In this stream will be borne away all the sewage which now contaminates our lake, and in the mighty rush of the waters it will be inoffensive and harmless. On the bosom of this great stream will sail the merchant marine of a new world of commerce, of which Chicago will be queenly metropolis, but which will benefit and enrich every village and town by which it passes. (Applause.)

Many of us will still be young men when this waterway, at whose birth we are now assisting, will be the great highway of the nation's trade, and to this end let us all work hopefully and in unison. (Applause.)

ADDRESS BY CORPORATION COUNSEL JOHN S. MILLER.

MR. PRESIDENT AND FELLOW CITIZENS:—I am instructed, Mr. President, to present to you the sincere regrets of his Honor, Mayor Washburne, that he could not be present with you and testify to his appreciation and gratification at the celebration of this event. And I extend to you my sincere sympathy that not he but I am called upon at this time to fill this place upon the programme.

Mr. President, the people of Chicago favor this project. The first municipal action upon it, I believe, was taken during

the administration of a distinguished citizen who is now present, and who can testify better than I, perhaps, in regard to the municipal history of this organization. Under his successor the great work was inaugurated, and the fact that the name of Mayor Roche is attached to the bill introduced in the Legislature for this work, testifies to his intelligent judgment and favorable action in pushing this enterprise. The next successor in the mayoralty was not only connected in a distinguished capacity with this work, but with almost all the later public works of the city of Chicago, and you have him here before you to-day and he can testify to the favor with which the project is looked upon by the people of the city.

Mr. President, the American people favor public improvements. No great public improvement has ever been undertaken in this country that has not received the support, the hearty financial support of the American people, prior to construction, and been pointed to with pride and satisfaction after its complete achievement. I was taught when I was a boy,—I am a native of the State of New York,—to look with reverence upon those men who pushed through the Erie canal. What more enduring monument can there be to a man than to be connected with such an enterprise? The people of the city of Chicago favor public improvement. The people of this grand valley, the people of this great commonwealth favor public improvements. No public improvement has been undertaken in the city of Chicago that has not received the solid support of its citizens, and that when adopted has not been pointed to with pride by the people of the whole country.

Look at the grand water works of the city, remarkable in their time, and unique. What work has done more to build up the city and attract to us strong and energetic men? There is but one peril that threatens our water system, and that is the sewage of the city. This great city, with now a million and a half inhabitants, is brought face to face with the sewage problem, and you, Mr. President, and gentlemen of the Board of Trustees, are charged with the responsible duty of the solution of that important problem. The people of the city of Chicago, the people of this Drainage District, support this grand enter-

prise. That is evidenced by the almost unanimous vote that was cast in favor of the adoption of this law.

Mr. President, you have some very distinguished men upon your programme, and I do not feel justified in taking up more of your time. I am authorized not only by the Mayor but by many of the officers of the city of Chicago, many of whom are present, to congratulate you upon this great work, and to bid you God speed in its accomplishment. (Applause.)

ADDRESS BY CONGRESSMAN THOMAS HENDERSON.

MR. PRESIDENT AND FELLOW CITIZENS:—In one respect, and only in one, I feel that I am like General Grant. I always like to have people stick to the programme. I looked over the programme on this occasion and I did not see that I was liable to be called upon for any remarks. I may tell you a little story. An old man who was very hard of hearing was walking on the railroad tracks, overtaken by a train and killed. After bewailing the event for some time, his wife sorrowfully remarked, "Well, the old man ought not to have been there." So I suppose it is with me. If I did not want to make a speech I ought not be here to-day. But I am here, and I want to congratulate the people of the great city of Chicago, and I want to congratulate the Northwest on the commencement to-day of this grand work, which I trust will never be discontinued nor suspended until there is a commercial waterway of magnitude constructed between the Great Lakes on the north and the Gulf on the south.

I am not very familiar with the sanitary part of this measure; that has been studied by the people of Chicago and by the scientific men of your city, and they have at last reached the conclusion that the effort is worth the expenditure of many millions to construct a waterway toward the Illinois river for drainage purposes for the great city of Chicago. And I can only say here to-day that I trust it will be in every particular a magnificent success, and that it may prove of great benefit to the city of Chicago, and not, as some apprehend, a detriment to the people of the Illinois valley.

I am in favor of waterways. I have been identified with waterways, and I take no greater pride in anything that I have ever done than I do in my connection with the improvement of the Great Lakes and the great waterways of the United States. Why, fellow citizens, there is nothing in which the people are more deeply interested than to give every facility for cheap transportation that is possible. It is very interesting when we think of it, that before the State of Illinois was admitted into the Union as a State, that some of our people, and notably Judge Pope, who was then a delegate in Congress, representing us there, foresaw that the great city of Chicago was to be built at some day, and that a great canal connecting it with the great Mississippi Valley was to be constructed, and therefore he favored departing from the ordinance of 1787, which would have made the Northern boundary of the State of Illinois an east and west line running through the southerly bend of Lake Michigan, and insisted on its going far enough north to include the great city of Chicago, which then did not have an existence. He spoke of its commercial importance, and he spoke of its national importance in view that in some future time, when our nation might develop internally, that our connection with the commerce of the lake would be an anchor to hold us to the union of the States. And so when the War of the Rebellion finally came, Chicago, with her patriotism, turned out her regiments of brave and gallant men and fought for the integrity of the Union and the preservation of the nation. (Applause.) Judge Pope ought to be remembered on an occasion like this. Chicago might otherwise have been in the State of Wisconsin. (Laughter and applause.)

Why I should be called upon to respond for the Illinois valley I hardly know. My friend, whom I see here, I think, knows very well that I was raised in the Spoon river valley and not in the Illinois river valley at all. Yet I have been close enough to it to know of some of its benefits to the people of the State of Illinois. With it the people will have cheaper transportation than they otherwise could possibly have ; and I want to see it get more and more of that as the years go by, and as it surely will if this great enterprise upon which

you have to-day actively entered is carried to completion and connection is made between the lakes and the gulf.

Some of the gentlemen who preceded me talked about the benefits of water transportation and cheaper transportation and of the canals which have been constructed at great expense for that purpose. Why, fellow-citizens, the water transportation which we have in the United States is worth \$200,000,000 to the people of this country annually. You take the immense commerce of the lakes, which is being increased every year by the almost millions of tons; if you had to transport that commerce by rail at the charges which they make for such transportation, and then compare it with what you can transport it by water navigation, it would make a difference of about one hundred and forty odd millions of dollars a year to the people of the United States.

Now, I am afraid I would get interested in this subject if I should continue, and speak a good deal longer than I wanted to. (Cries, "Go on," "Go on.") Really, when I appeared in response to the call, which I had no reason to anticipate until a few moments ago, I only intended to congratulate the people of Chicago and the people of Illinois on this auspicious day and event.

The people of Illinois take pride in their great State, and they ought to take pride in it. They ought to be willing to concede anything to it that should be conceded in justice to its commercial importance and value to the people of the country, for affording us such a great market for all our surplus products, of our farms and factories.

Now, I thank you for having listened to what I have said, and trust you will excuse me from making any further remarks. (Applause.)

ADDRESS BY DR. FRANK W. REILLY.

MR. PRESIDENT, LADIES AND GENTLEMEN:—The receipt of the invitation from the Trustees of the Chicago Sanitary District to represent the press, and to respond for it on this occasion at once recalled to mind a passage in the address of the president of the American Public Health association at its session in the city of New Orleans. Referring to the agency of the press in sanitary matters, Dr. Billings said his examination of the several large volumes of clippings on this subject which he accumulated every year reminded him of the ingenious Irishman who put his gas meter on upside down, and at the end of the month the register showed the company in his debt.

It is not difficult to recall sundry newspaper articles on the great waterway which could only be adjudged to have aided in achieving the present consummation in a topsy-turvy world, where meters are used upside down and register the wrong way, where the hands on the clock of progress always turn backward. But such articles have been the notable exceptions, and it is doubtful if they have retarded by a single hour the ceremonies we witness to-day. They may be dismissed from present consideration in the optimistic belief that,—as bitter tonics do in medicine,—they have subserved a useful object in strengthening and invigorating the purpose and the efforts of those who have so successfully labored for this beginning of the end.

Almost without exception, every public enterprise, every public work of magnitude at all approaching that of the Chicago Sanitary District, is the creation and the outcome of some agency especially devised for the purpose. It is through such special agencies that railroads extend their network over the continent; that the slender filaments of telegraph systems connect the thought ganglia of the country; that docks and piers and lighthouses and harbors and watercourses are built or improved or created. The Chicago Sanitary District is an exception to this rule. No coterie of capitalists seeking a profitable investment; no legislative body casting about for a subject

for "An Act entitled an Act;" no self-seeking politician. Well, if such a one ever succeeded in identifying himself with the Sanitary District he speedily found himself in uncongenial company, and either by his own volition soon dropped out or was relegated to a condition of innocuous desuetude.

The Sanitary District is essentially and distinctively the creation of the public press of the city of Chicago and of the Illinois valley. The egg from which it was hatched was laid in a newspaper office a little over seven years ago. It was incubated by the newspapers, and the newspapers did the proper and necessary cackling at the various stages of its evolution. To the fact that for over six of these seven years I was actively connected with one of those papers, and more especially with the work of that journal in the interest of the great sanitary waterway, is probably due the honor conferred upon me to-day. That connection is suspended temporarily at least, and therefore I may without violating the proprieties say what an active newspaper man,—one still in the harness,—would hesitate to say as to the agency of the press in making possible these ceremonies.

No other one subject during the last seven years has been given so much space in the columns of the daily press as this enterprise. No other topic has received so much careful thought and study, nor has any been treated and advocated from more entirely disinterested motives. It is true that nothing with which the press has dealt during that period is fraught with such transcendent material possibilities. But it is also true that those possibilities have been made possible only by the efforts and through the agency of the public press.

There is in this fact the promise and the potency of the largest measure of success,—of a future development of Chicago and the Illinois valley greater even than that conceived in the imagination of that practical and most imaginative of engineers, the distinguished chairman of the engineering committee of the district. Given the support of her public press on which to pose the lever of the drafting pencil, and Chicago may truthfully exclaim: "The world is mine!"

ADDRESS BY CARTER H. HARRISON.

MR. PRESIDENT, GENTLEMEN OF THE BOARD, AND LADIES AND GENTLEMEN IN THE AUDIENCE:—This is taking an undue advantage of me. Somebody else was invited to speak, another was asked to talk, and failing to appear, I am made to take his place without preparation. But it is said of me that I am windy. (Laughter and applause.) I will ask you to hoist your sails and I will try to fill them for two or three minutes. I wish I were some thirty years younger. I may not live to see that which has interested me ever since I came to Chicago, the opening of a mighty channel, a river, not a canal, but a river having its source in Lake Michigan and washing its way on through this beautiful valley, down the Mississippi to the Gulf of Mexico. One hundred and five years ago the ordinance of 1787 was adopted. In it were two clauses of immense moment; one was that there should never be the home of a slave on the territory ceded by Virginia. (Applause.) That was for awhile carried out in spirit, but fugitive slaves came across the Ohio, and the laws of the United States carried them back. But at last there was the dread arbitrament of war, with cannon, musketry and tramp of armed men, and then slavery was wiped out forever, and there can be no slave who will ever tread upon the prairies that surround us here. (Applause.)

The other monitory clause of that ordinance was, that the rivers and carrying places between the Mississippi River and its waters, and the lakes, should be forever free from tolls, yet yonder little stinking ditch (pointing to the canal) has been exacting toll for every stone that is carried upon it, for every bushel of wheat and corn. But now, thank heaven, the ordinance of 1787 is going to be carried out, and the carrying places, the heritage of all, will be forever free from tolls to the American people. (Applause.) Some of the gentlemen have alluded to the portage here as being a fit one in which the great channel should be cut. Aye, gentlemen, long before man was created, before he sprang from the dust at the hands of his God, the Eternal, the Mighty Engineer, had, with a glacier, cut deep

into the solid rock along this line here, and marked where was to be made this great river. (Applause.) These engineers—Mr. Cooley may flatter himself (laughter)—Mr. Williams may take pride in it, but a higher engineer than they, requiring no compass, no chain, no level, ploughed into the rocks, carried boulders along in the arms of the mighty ice, and marked the way from Lake Michigan to Joliet, over which the channel of this river shall be dug. This idea took so strong possession of me that, when I had the honor of being a member of Congress, I determined, if only the people would stick by me and keep me there (laughter and applause), that I would fight it out on that line “if it took me all summer” and build this canal. I introduced an Act in Congress. It was very near passing the House, but for the death of one great, grand, big man from Texas, brave old Schleicher, it would have been recommended by the Committee on Commerce, and would have been passed. I then, as Mayor of Chicago, told the people of that city: “You have been asking the General Government to dig this canal. Do yourselves what Hercules did, put your own shoulder to the wheel and lift the cart out, and then maybe the government will push it through.”

My name will not go down connected with this thing. Many a man,—Judge Pope and others,—who dreamed of this so long ago will never be heard of in it. Frank Wenter’s name will go down. (Laughter and applause.) Ah, gentlemen, don’t take this as flattery, the name of Frank Wenter and this Board will go down the stream of ages as the builders and starters of this mighty enterprise. (Great applause.) I wanted to be a Drainage Commissioner. (Laughter.) I tried hard to get it. (Applause.) If I had been I would have fought like the devil to be President of the Board (laughter and applause), so that I could have used that shovel to-day instead of Frank, but Frank got there and I did not, and he has used the shovel and wielded it well. (Laughter and applause.)

But, however, I am only glad that the Drainage Canal is being built. The time for discussion is passed. I want a ship canal that will marry the 12,000 miles of navigable waters of the Mississippi river, with the 5,000 miles of shore line of the

Great Lakes. (Applause.) The canal for commercial purposes is absolutely essential to this great State and to the Nation. (Applause.)

Mr. Eckhart has told you of canals in other lands. Here in America it was thought that canals were no longer necessary,—that railroads were doing everything. Aye, the railroads were doing everything, and they were charging you and me “everything” for what they did. Canals alone can regulate the prices of transportation. Go along the line of that little canal over there, and every bushel of wheat or corn carried to Chicago pays a freight of one, two or three cents less per bushel because that little canal competes with the Santa Fe, the Rock Island and the Alton railroads. The canal makes freight rates cheap. In England even great railroads dig canals along their lines. The Great Western, running from London to Liverpool, has a canal of its own so as to carry heavy freight, giving the railroad the lighter ones, and thus makes traffic cheaper. In France, to Paris, from every direction, converge canals, and but for that the French people would not be the prosperous people that they are to-day. Germany owns her railroads to a great extent, or owns a large amount of stock in them, yet Germany makes navigable every river in her domain, so that they compete with the railroads, thereby helping the people. The people here are the masters,—and if Mr. Henderson were not here and a member of Congress, I would say that the railroads are to a great extent the masters of the people’s servants, the legislators. (Laughter and applause.) But we are the people and the masters. Let us build canals. We pay \$100,000,000,—more than \$100,000,000,—a year to fellows that went to fight but who never smelt powder. I have got through now. I am not a candidate for office, and, therefore, I am not afraid of the old soldier vote. (Laughter and applause.) If the Government, when that \$100,000,000 was lying idle in its treasury, had used it rightly they would have improved this canal here; they would have dug the Erie canal and married Long Island Sound with Lake Erie. They would have dug a canal across the Chesapeake peninsula, and ultimately they would have dug the mighty ditch that is to transfer the ship of

the eastern market to the western market through the Nicaragua. (Applause.)

I believe in waterways. I am glad that the people were scared in Chicago, that they got frightened about the cholera, or some other epidemic, and have put their shoulder to the wheel. The United States Government, I hope, will step in. Tom Henderson, it looks as if you will live a hundred years and always be in Congress. (Laughter and applause.) Make it your business, Tom, from this time out to fight that the United States Government will take up the labor that the City of Chicago has commenced at a cost of twenty millions of dollars, and make a canal from Lake Michigan to the Mississippi. If such a canal had existed when our late unpleasantness broke out, the United States would not have bluffed and blustered as she did in the Mason and Slidell affair and then back down like a whipped coward. (Applause.) Make us a canal so that we shall not care for the Welland. Suppose we got into a fight to-morrow with England. She would pour into our lake her gunboats and corvettes, and Marshall Field would tremble in his boots,—other rich men would tremble,—and would be ready to pay out one or two of his millions to keep the British guns from battering down Chicago. (Laughter and applause.) What if we got into a war with England? The lake cities would be battered down unless we were forehanded and took possession of Canada,—and I believe we would do just that. Just as soon as we get into a quarrel with England, before the “damned lie” is passed, when it means fight, let us take Canada and have it all right. But if we were to get into war with England now, tribute would be demanded of every one of the cities that border upon the lakes; and we would be helpless. But here is a canal that when finished will enable us to put gunboats on the Illinois river, and as soon as the tocsin sounds we will blow the English corvettes out of water, and then have easy and plain sailing. (Laughter and applause.)

My friends, I am glad to meet you; I am proud to be here; and I hope when the time shall come, not long years hence, when the history of this mighty undertaking shall be read, that my children's children and great-grandchildren afterwards fol-

lowing, will say that their grandfather or great-grandfather looked on while Frank Wenter was digging that hole. (Laughter and applause.)

ADDRESS BY EX-SENATOR JAMES R. DOOLITTLE.

MR. PRESIDENT, GENTLEMEN AND FELLOW CITIZENS:—I rejoice to be present on this occasion and see the inauguration of this great work. It is a joy to me to see it begun, and it will be a joy unspeakable if I live to see it end, as I hope to do. It is a great work for Chicago, because it will secure pure drinking water. It will secure perfect drainage. It will secure its commercial supremacy. It will make Chicago the head of river navigation, as she now is the head of lake navigation. It will make her the queen of the rivers as well as the queen of the lakes. It will do very much to secure Chicago in case of war with Great Britain. God grant no war with Great Britain will ever come again, but we must not forget that from ancient times the Briton has always been aggressive and warlike. I rejoice because it is a great work for the State of Illinois as well as the city of Chicago. By pouring a stream twenty feet deep and three hundred feet wide through the counties of Will, Grundy and La Salle, it will create at least six water powers greater than the water power of Lowell, Massachusetts. It will build up in the heart of Illinois great manufacturing cities. It will add to the natural forces of Illinois what would be equivalent to a force of 100,000 horses and a million of men. It will add vastly to the wealth, population and resources of this great State.

I rejoice also because it is a great national work, a great work for the United States, for when this flood of water shall pass down over the Divide near this point until it meets the Illinois river at La Salle, the Government of the United States will undoubtedly join hands with Chicago and with the State of Illinois to build the locks and dams which will secure this great navigable waterway.

Fellow citizens, I shall not detain you except to say that in my opinion not only the city of Chicago, but the State of Illi-

nois and the United States of America ought to join Chicago and help bear this great expenditure. If the city of Chicago and the Drainage District shall pay one-half of the fifty millions which it will probably cost before it is completed as a great waterway, the State of Illinois could afford to pay one-quarter and the Government of the United States pay the other quarter to secure its complete achievement. I had occasion to say as early as 1886, that, as to the Lower Mississippi, this great work now begun by Chicago will do more for the navigation of the Lower Mississippi than any other thing that has ever yet been conceived. A volume of water fifteen feet deep and two hundred feet in width spread upon three thousand feet of surface will increase the depth at least a foot, so that at low stage of water at St. Louis it will be increased by one foot at least, and at Memphis by at least six inches.

I therefore conclude as I began, sir, by saying that I rejoice to be here, and I pray God that I may live,—though I am past seventy years of age,—to see this work completed and this great waterway established between the lakes and rivers. I say it with just as much earnestness as if all my interests were identified with Chicago. I still live in Wisconsin. I live in the State to which Chicago belongs according to the ordinance of 1787. (Laughter and applause.) I sometimes give an excuse to those gentlemen who ask me, “Why is it you practice law in Chicago, and yet live in Wisconsin?” I tell them that by the ordinance of 1787 Chicago belongs to Wisconsin, and I have a right to be there. But, independent of all that, my interests are of a national character. Living as I do in Wisconsin, I still wish to see this great waterway, for it will be in the end to the commerce of the United States of more importance than the Suez canal, and of equal importance to the Nicaragua canal which is to connect the Atlantic and Pacific oceans. (Applause.)

I thank you for the honor of your attention.

ADDRESS BY EX-CONGRESSMAN RALPH PLUMB.

MR. PRESIDENT, LADIES AND GENTLEMEN :—I do not see that there is anything for me to say. I have listened with great interest to every word that has been uttered since these exercises commenced, and I cannot recall a single word or sentence but what has been most fitly spoken. And, now, so near at the close, there is but one idea I have to supplement what has been already said. We have been told during these speeches much about great waterways, and that they ought to be built by the United States. I want to say that the United States of America is abundantly able to build all the waterways that it needs ; and this is the single point that I would urge. This is like a great farm ; this country which spreads from ocean to ocean, from the lakes to the Gulf, is like one great farm fenced off into fields that we call our States ; and it is, after all, one great farm. There is not an impediment to commerce from State to State throughout the whole domain. The Government should be like a good farmer who looks out over his farm and does all that is necessary to be done for the best development of his possessions. If there are any farmers here present with 320 or 640 acres,—you know how to look to see whether it can be benefited by a drain there, or a ditch here, by tilling this field and sowing that, and whatever you do you do because you are able to do it, and you are wise enough to do it. Uncle Sam is rich enough to do it. Did you ever think of the riches of this great Nation ? We do not reflect upon it as we ought. We have 65,000,000 of people. How many of them are producers of wealth ? Think of it, how many of the 65,000,000 ? I dare say that there are 25,000,000 of the 65,000,000 that in one way or another are producing wealth,—the man who shovels, the man who plows, the man who builds. The man who sells goods,—he does the least of it. The banker helps ; everyone almost is employed in adding to the wealth of this great nation. We have that wealth gathered ; we are not throwing it away as they are in other countries. Look at the great countries of Europe where they have their standing armies, and the hun-

dreds of millions necessary to support these armies in idleness or worse than idleness, leeches upon those who do labor. But there is nothing of that kind here. We are paying off old soldiers, and doing it gratefully for what they have done for the country. Our standing army is only 25,000 men, and we are gaining in wealth so fast that each year Congress should be called upon to make appropriations to build canals here and there, and it will not impoverish us at all. We shall not know that we pay the taxes, but we shall know that each year we are growing richer and richer, and I have sometimes been afraid that we should all catch the spirit of money-getting. We have all been in the habit of thinking that if we could save a little on our taxes we could make money by it, but we must remember this great adage of the Bible, "That they who withhold more than is meet, it tendeth to poverty." We must not do that. We must enter upon this great work and furnish gladly the money, not only to build this canal between the lake and river, but to make a great harbor at Chicago and to connect us with the Gulf of St. Lawrence, and other work all through our great land. They should all be carried forward by us, and until they are, we have not done everything that is necessary to do for the growth and prosperity of the American people. (Applause.)

ADDRESS BY SENATOR THOMAS C. MACMILLAN.

MR. PRESIDENT, LADIES AND GENTLEMEN :—After having heard so many and such a variety of speeches it is too late for me to say any thing to-day that will be new on this important subject. I simply desire to state that it was my good fortune, together with Mr. Eckhart, who is now a Trustee, and with ex-Mayor Roche, of Chicago, Representative Riley, of Joliet, and the late Senator Bell, of Peoria, to act as a commission by appointment of the General Assembly, to prepare the bill which is now known as the Sanitary District Act. We simply did our duty in the General Assembly, representing the people of the city of Chicago, and of the Illinois valley. We claim no credit for doing our duty. We are glad to do that, and we are

glad to-day that the Drainage Trustees are doing their duty. We are glad to be here and see they are doing it, and we hope this great enterprise will be completed, not only in our day, but in the day of such men as ex-Mayor Harrison, of Chicago, who years ago did so much to bring this great enterprise about.

I thank you, Mr. President and gentlemen, for calling upon me, and I hope we may all meet here some day when there will be great vessels floating up and down this valley, and probably at another time we may have a better time. (Applause.)

ADDRESS BY MAYOR P. C. HALEY.

MR. PRESIDENT, LADIES AND GENTLEMEN :—I had supposed you had listened to speeches enough and did not expect to be called upon on this occasion, but being called I deem it my duty to respond. We have, as said by Mr. Eckhart, a “condition confronting us, not a theory.” We have had that condition present for a great number of years, and it has steadily been growing worse. It reached that point where the people, not only in Joliet, but along the entire valley, insisted and demanded that something should be done. The people of Joliet have united with the people of Chicago, hand in hand, with their friend, to secure such legislation as would relieve the citizens of Chicago as well as the people of Joliet and the people of the valley. Our citizens and committees representing them have coöperated with like committees from Chicago, in framing the present Act under which the work which was so auspiciously begun to-day is expected to be consummated. All the people of the valley and all the people of Joliet are satisfied when the Board of Trustees honestly and in good faith live up to the letter and spirit of the law. (Applause.) We expect and we believe that if a channel of the size and capacity which that law requires the Trustees to make, is made, and the volume of water turned into it which the law requires, and the sewage diluted before it is turned into the channel as the law requires, that it will not only answer the purpose of Chicago, but that it will also give Joliet that relief which we be-

lieve we are fairly and justly entitled to. We have noticed with pleasure for the last few months an honest effort on the part of the Trustees to carry out this Act in every particular. We are pleased with their methods, we are pleased with the expedition with which they have carried on their work, and sincerely trust that the work so well begun to-day, will not be discontinued until the channel is made such as the law requires, and then that the State and National Governments will take it up and make it the great waterway which has been so eloquently pointed out here to-day by the various speakers who have preceded me.

I thank you for your attention. (Applause.)

ADDRESS BY FERNANDO JONES.

MR. CHAIRMAN, LADIES AND GENTLEMEN :—I do not know why I am called upon except it may be that I was here early, and present at the formal inauguration of the digging of the original Illinois and Michigan Canal.

Perhaps I may as well say, I was born about the time the Erie Canal was completed. I remember the final ceremony of the Erie Canal, by the pouring of a barrel of water from Lake Erie into the Atlantic Ocean. On the 4th of July, 1836, the Illinois and Michigan Canal was formally begun by digging and wheeling out a lot of sod. On that occasion there was some prophecy. Dr. Egan made a speech, after having read the Declaration of Independence, and Judge Theophilus W. Smith, Chief Justice of the Supreme Court of the United States, —by the way he has a grandson here, who is a son of ex-Mayor Plumb,—he said: "Fellow citizens, while neither a prophet nor the son of a prophet, yet I feel the spirit of prophecy in me this day. Fellow citizens, in ten years from this time you will see a city on the borders of Lake Michigan containing ten thousand people. Yes, fellow citizens, in twenty years you will see twenty thousand, and in fifty years, you will see a city of fifty thousand people."

An Irishman present, who was afterwards sheriff, called out

to him, and said: "Aye, aye, Judge, now, we won't be here, so we can't see how big a lie you are telling," but that didn't stop the Judge. He said: "Yes, fellow citizens, in one hundred years from this time you will see a city of one hundred thousand people!" But that was too much for the boys. They gathered and took him off the barrel he was standing on and gave him a little something to drink, and scattered water in his face. After a while some one asked him "How do you feel, Judge?" He said he felt better. "Arrah," said the leader to the Judge, "if we had not stopped you, you would have made it a million." (Laughter.)

Now, I am on reminiscences; I suppose that is the occasion of my being called. I remember when that original canal was established; it was to be a ship canal, an immense affair, and the first lawyer of Chicago, Reuben E. Hickox, had said we were not able to build a ship canal, that we "ought to build a shallow canal," and they gave him the name of "Old Shallow-Cut." I have a picture of the old gentleman attempting to pump water up from Lake Michigan into a shallow canal among the frogs, but all this opposition to the old lawyer Hickox didn't count, because on the 10th day of May, 1848, if my memory serves me, we had an opening of a canal under the auspices of the Canal Trustees. Foreign bondholders had furnished some more money to build the canal on the shallow-cut principle, and "Old Shallow-cut Hickox" was present on the occasion when they opened the shallow-cut canal, and he was vindicated. It looked then as if he were right, but in the progress of events it is found that these old fogies were wrong. We may not have been able, we were not able to build a deep cut then, but we are able to build a deep cut now (cries "Yes, and we will do it"), and it will be a great advantage to every interest.

RESOLUTIONS ADOPTED.

WHEREAS, The law under which the Sanitary District was organized was matured by a Commission of five appointed by joint resolution of the Thirty-fifth General Assembly of Illinois in 1887, said Commission being instructed to examine the subject matter and report a bill to the Thirty-sixth General assembly;

WHEREAS, Said Commission consisted of the Hon. John A. Roche, president; Senator B. A. Eckhart of Chicago, Senator A. J. Bell of Peoria, the Hon. Thomas C. MacMillan of Chicago, and the Hon. Thomas H. Riley of Joliet, and their labors were performed without compensation and at much personal sacrifice, and in a manner eminently satisfactory to the people of Chicago and of the Illinois valley;

WHEREAS, The Sanitary District is equally indebted to many disinterested and patriotic men, who have labored in the cause from its inception, and who have promoted the interests of this work, whose names cannot be recapitulated at this time; therefore, be it

Resolved, 1. That this Board and the people recognize fully the great labors performed, and the causes that have contributed to the consummation of this most important enterprise.

2. That the Board cause to be prepared an official history, which shall set forth the leading events of interest in connection with the inception and promotion of this work.

CHRONOLOGICAL TABLE.

Lake Michigan discovered by Nicolet,	-	-	-	1634
Desplaines Valley discovered by Joliet and Marquette,	-	August,	1673	
Joliet suggests Waterway,	-	-	-	1674
Washington favors canals,	-	-	July 19,	1787
First Official suggestion of Illinois canal,	-	-	August 3,	1795
Worthington proposes Government aid of canals,	-	-	March 2,	1807
Gallatin's report on roads and canals,	-	-	April 6,	1808
Porter urges Illinois canal,	-	-	February 10,	1810
Indians cede site of Chicago,	-	-	August 24,	1816
Indians cede Desplaines and Illinois Valleys,	-	-	August 24,	1816
Storrow urges Waterway,	-	-	December 1,	1817
Long shows importance of Waterway,	-	-	May 12,	1818
Darby argues for Waterway,	-	-	-	1818
Illinois becomes a State,	-	-	-	1818
Calhoun's Report on canals,	-	-	January 14,	1819
First Act by Congress aiding Illinois canal,	-	-	March 30,	1822
First canal legislation by State,	-	-	February 14,	1823
First surveys for canal,	-	-	-	1824
Illinois and Michigan Canal association, incorporated,	-	-	January 17,	1825
Congress grants alternate sections for canal,	-	-	March 2,	1827
Hoffman urges Illinois canal,	-	-	January 10,	1834
Chicago Council orders public well,	-	-	November 10,	1834
Chicago Hydraulic Company incorporated,	-	-	January 18,	1836
Illinois and Michigan canal begun,	-	-	July 4,	1836
First survey of Illinois river,	-	-	-	1838
Canal in hands of trustees,	-	-	-	1845
Chicago datum established,	-	-	-	1847
Chicago river and harbor convention,	-	-	July 5,	1847
Bridgeport pumping works constructed,	-	-	-	1848
Illinois and Michigan canal completed,	-	-	April 23,	1848
Chicago City Hydraulic company incorporated,	-	-	February 15,	1851
Board of Sewerage Commissioners created,	-	-	February 4,	1855
E. S. Chesbrough elected chief engineer sewerage system,	-	-	-	1855
Chicago's sewerage system planned,	-	-	-	1855
Canal in Sixteenth street proposed,	-	-	-	1855
Work on Chicago sewers begun,	-	-	-	1856

Water supply tunnel suggested,	- - - - -	1859
Board of Public Works organized,	- - - - -	May 6, 1861
Congress defeats ship canal bill,	- - - - -	February 9, 1863
Report of committee on statistics,	- - - - -	June, 1863
National canal convention,	- - - - -	June 2, 1863
First water supply tunnel begun,	- - - - -	March 17, 1864
Plan for cleansing Chicago river reported,	- - - - -	March 6, 1865
Canal through Thirty-ninth street proposed,	- - - - -	March 6, 1865
Canal through Fullerton avenue proposed,	- - - - -	March 6, 1865
First water supply tunnel completed,	- - - - -	December 6, 1866
Surveys by General Wilson,	- - - - -	1866
Surveys by Wilson and Gooding,	- - - - -	1867
Ogden-Wentworth canal constructed,	- - - - -	1871
Canal restored to State,	- - - - -	May 1, 1871
Canal deepened,	- - - - -	July 15, 1871
Lock at Henry completed,	- - - - -	January, 1872
Bridgeport pumps sold,	- - - - -	June 25, 1873
Second water supply tunnel constructed,	- - - - -	1874
Dam in Ogden-Wentworth canal constructed,	- - - - -	June, 1877
Lock at Copperas Creek completed,	- - - - -	October, 1877
Fullerton avenue conduit completed,	- - - - -	January 9, 1880
Surveys by Benyaurd and Wisner,	- - - - -	1882
Bridgeport pumps rebuilt,	- - - - -	July 3, 1884
Drainage and Water Supply Commission created,	- - - - -	January 27, 1886
Winston bill before Legislature,	- - - - -	1887
Hurd bill before Legislature,	- - - - -	1887
Report of Hering commission,	- - - - -	January, 1887
Legislative Drainage Commission appointed,	- - - - -	May, 1887
Shore inlet tunnel built,	- - - - -	1887
Surveys by Marshall,	- - - - -	1889
Sanitary District law enacted,	- - - - -	May, 1889
Henry and Copperas Creek works ceded to United States,	- - - - -	June 4, 1889
Supreme Court affirms validity of law,	- - - - -	June 12, 1889
Chicago Sanitary District defined,	- - - - -	October 14, 1889
La Grange lock and dam completed,	- - - - -	October 21, 1889
Chicago Sanitary District established,	- - - - -	November 5, 1889
First Trustees elected,	- - - - -	December 12, 1889
First meeting of Trustees,	- - - - -	January 18, 1890
Murry Nelson elected president,	- - - - -	February 1, 1890
Lyman E. Cooley elected chief engineer,	- - - - -	February 1, 1890
Austin J. Doyle elected clerk,	- - - - -	February 1, 1890
S. S. Gregory elected attorney,	- - - - -	February 1, 1890
Byron L. Smith elected treasurer,	- - - - -	February 1, 1890
Charles Bary elected secretary,	- - - - -	February 1, 1890
Attorney Gregory resigns,	- - - - -	June 26, 1890

Clerk Doyle resigns,	July 1, 1890
Thomas F. Judge elected clerk,	July 12, 1890
George W. Smith elected attorney,	July 20, 1890
Richard Prendergast elected president,	December 2, 1890
John Newton elected consulting engineer,	December 10, 1890
Chief Engineer Cooley resigns,	December 10, 1890
William E. Worthen elected chief engineer,	December 17, 1890
Secretary Bary resigns,	December 31, 1890
Newton and Worthen's first report,	January 10, 1891
Newton and Worthen's second report,	February 21, 1891
Amendment of law proposed,	March 21, 1891
Engineers Newton and Worthen resign,	April 21, 1891
Attorney Smith resigns,	April 25, 1891
Samuel G. Artingstall elected chief engineer,	May 9, 1891
Artingstall's first report,	May 23, 1891
Adams A. Goodrich elected attorney,	June 13, 1891
Artingstall's second report,	June 20, 1891
Trustees Nelson and King resign,	August 26, 1891
Artingstall route adopted,	September 16, 1891
Trustee Willing resigns,	September 23, 1891
William Boldenweck elected Trustee,	November 3, 1891
Lyman E. Cooley elected Trustee,	November 3, 1891
Bernard A. Eckhart elected Trustee,	November 3, 1891
Trustee Wenter elected president,	December 8, 1891
President Wenter outlines policy of Trustees,	December 8, 1891
Trustee Boldenweck chairman judiciary committee,	December 8, 1891
Trustee Cooley chairman engineering committee,	December 8, 1891
Trustee Eckhart chairman finance committee,	December 8, 1891
Trustee Gilmore, chairman federal relations committee,	December 8, 1891
Office of secretary abolished,	January 12, 1892
Trustee Hotz resigns,	January 16, 1892
Chief Engineer Artingstall resigns,	January 16, 1892
Benezette Williams elected chief engineer,	January 16, 1892
Treasurer Smith resigns,	January 23, 1892
Melville E. Stone elected treasurer,	January 23, 1892
Williams' first report on routes,	February 17, 1892
Attorney Goodrich resigns,	February 24, 1892
Orrin N. Carter elected attorney,	February 24, 1892
Route from Willow Springs to Lockport adopted,	March 26, 1892
Route from Bridgeport to Willow Springs reported,	June 7, 1892
First Bids opened,	June 8, 1892
First contracts awarded,	July 13, 1892
Inauguration of work,	September 3, 1892
Four mile tunnel opened,	November, 1892

Thomas Kelly elected Trustee, - - -	November 8, 1892
William Martin elected sanitary inspector, -	November 30, 1892
President Wenter re-elected, - - -	December 6, 1892
Trustee Boldenweck, chairman federal relations committee, - - - - -	December 14, 1892
Trustee Gilmore, chairman committee on health and public order, - - - - -	December 14, 1892
Trustee Kelly, chairman judiciary committee, -	December 14, 1892
Trustee Russell, chairman committee on rules, -	December 14, 1892
Chief Engineer Williams resigns, - - -	June 7, 1893
Isham Randolph elected chief engineer, - - -	June 7, 1893
Edward Williams elected marshal, - - -	July 5, 1893
Kampsville lock and dam completed, - - -	August 30, 1893
Desplaines river diverted to new channel, - -	November, 1893
President Wenter elected president third time, -	December 5, 1893

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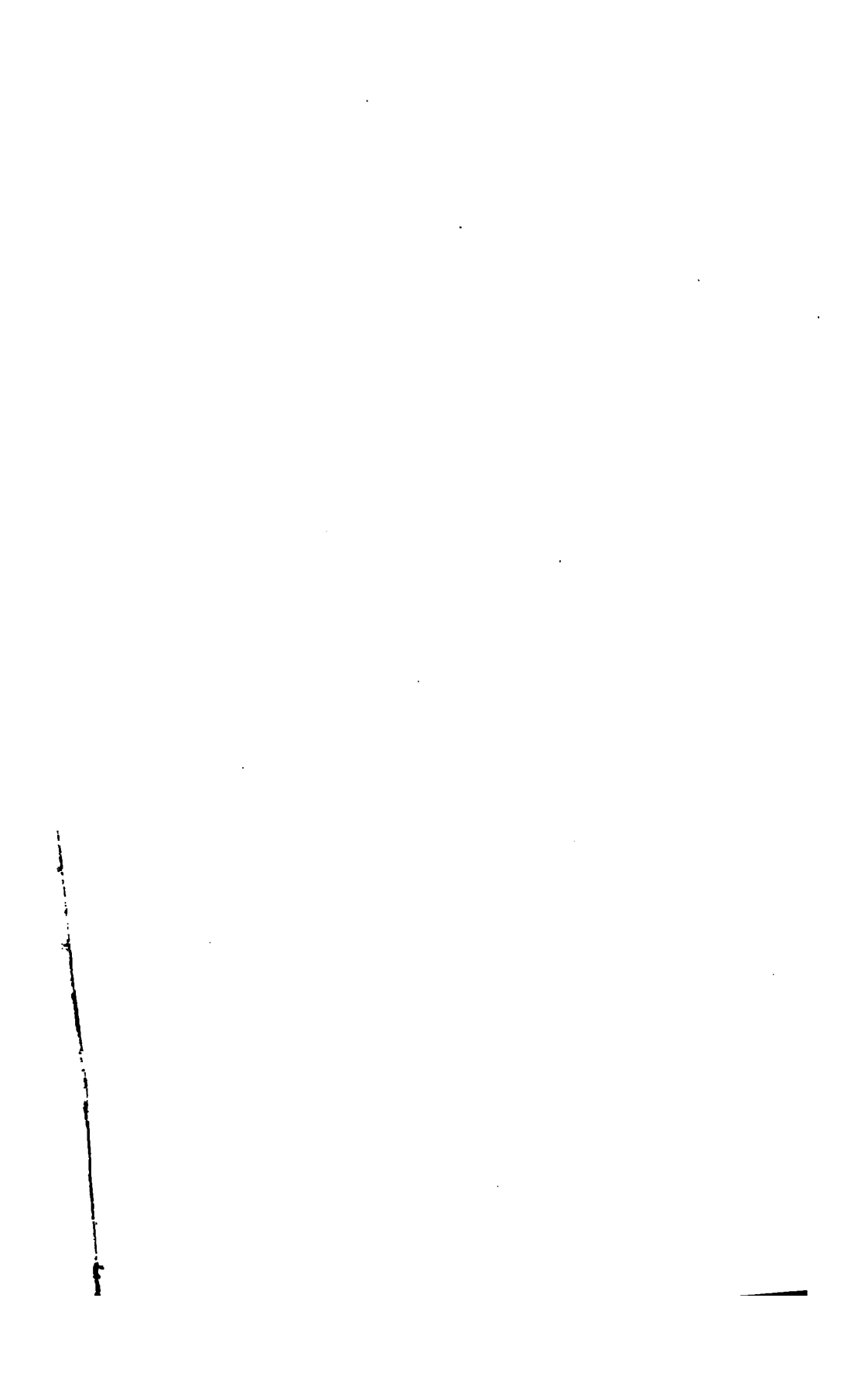
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